Camas Creek Subbasin Total Maximum Daily Load

2016 Temperature Addendum

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Acknowledgments

Cover photo is Camas Creek above Magic Reservoir taken October 2, 2014, by Mark Shumar (Idaho Department of Environmental Quality).

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Abbreviations, Acronyms, and Symbols

§303(d) refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section

AU assessment unit

BMP best management practice

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations

CGP Construction General Permit

DEQ Idaho Department of Environmental Quality

EPA United States Environmental Protection Agency

GIS geographic information systems

IDAPA Refers to citations of Idaho administrative rules

kWh kilowatt-hour

LA load allocation

LC load capacity

m meter

MOS margin of safety

NB natural background

NPDES National Pollutant Discharge Elimination System

NREL National Renewable Energy Laboratory

PNV potential natural vegetation

SWPPP Stormwater Pollution Prevention Plan

TMDL total maximum daily load

US United States

USC United States Code

WAG watershed advisory group

WLA wasteload allocation

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Executive Summary

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to §303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards).

States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 water bodies in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses 7 water bodies (14 assessment units [AUs]) in the Camas Creek subbasin that have been placed in Category 4a of Idaho's most recent federally approved Integrated Report (DEQ 2014) because of an approved TMDL. This document revises the temperature TMDL portion.

This addendum describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Camas Creek subbasin, located in south-central Idaho. For more detailed information about the subbasin and previous TMDLs, see the *Camas Creek Subbasin Assessment and Total Maximum Daily Load* (DEQ 2005a) and the *Camas Creek Subbasin Five-Year Review* (DEQ 2016).

The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards. It also identifies implementation strategies—including reasonable time frames, approach, responsible parties, and monitoring strategies—necessary to achieve load reductions and meet water quality standards.

Subbasin at a Glance

The Camas Creek subbasin is located in south-central Idaho (Figure A). Camas Creek is the main water body that drains the subbasin. The headwaters of the creek originate in the flat Camas Prairie, flow east through the prairie, and then discharge into Magic Reservoir. Two bioregions exist within the subbasin: the headwaters of the tributaries that feed into Camas Creek from the north originate in the Northern Rockies, while the remainder of the subbasin lies in the Snake River Plain/High Deserts. Transitional zones exist between the two ecoregions.

In 1998, 12 water body segments (16 AUs) of the Camas Creek Subbasin were identified as impaired. Many of these water bodies have been identified within the 1998 §303(d) list as impaired by unknown pollutants; a couple were identified as impaired by bacteria, dissolved oxygen, nutrients, sediment, and flow alteration. Subsequently, 7 of the 12 water bodies (14 AUs) were identified as temperature impaired and received a temperature TMDL (DEQ 2005a).The beneficial uses that were being impaired by pollutants were cold water aquatic life, salmonid spawning, primary contact recreation, and secondary contact recreation.

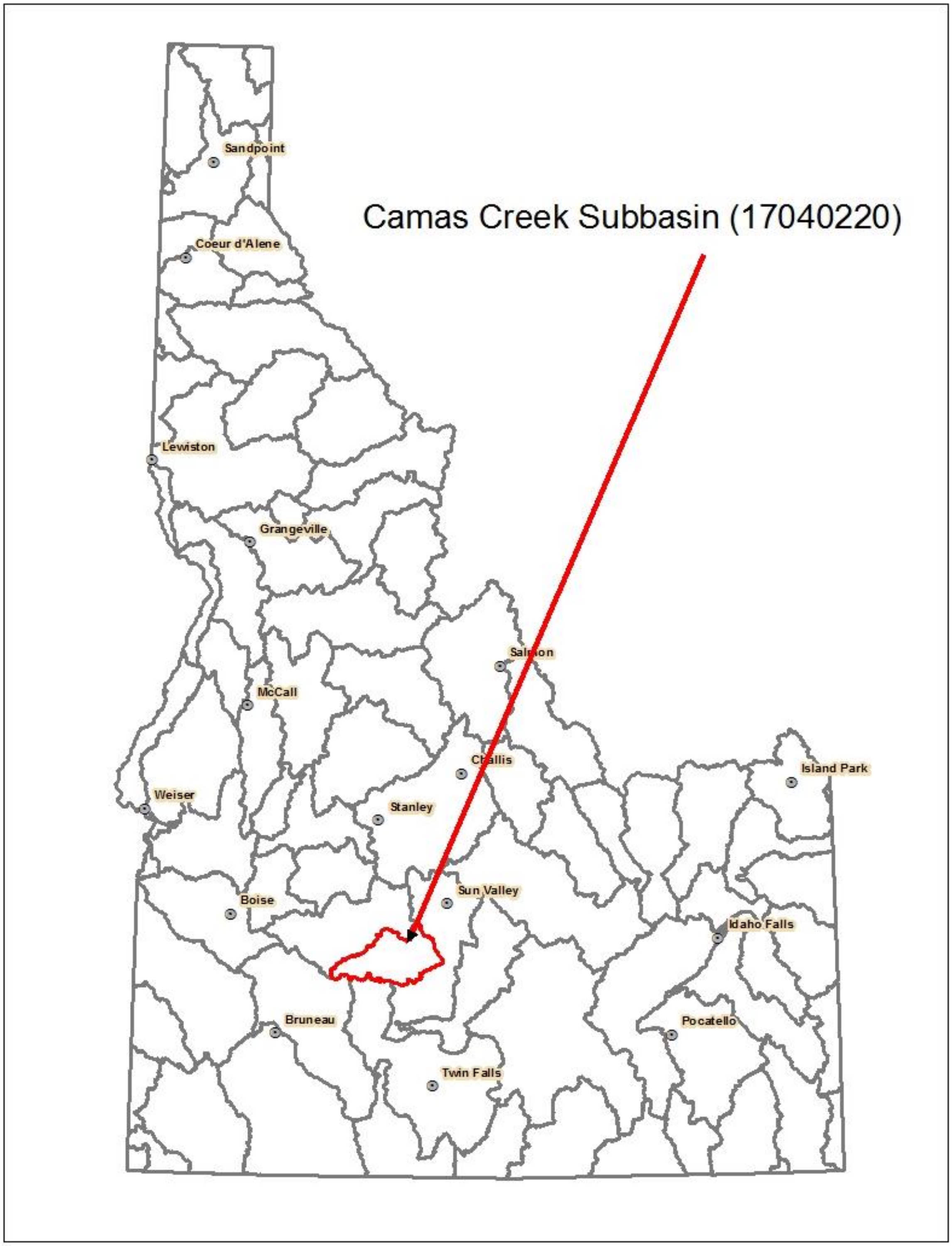

Figure A. Camas Creek subbasin.

Key Findings

Seven water bodies (14 AUs) were placed on the 2012 Integrated Report Category 4a list of impaired waters with approved TMDLs for reasons associated with temperature criteria violations, and the Idaho Department of Environmental Quality (DEQ) has revised temperature TMDLs for these waters (Table A).

In this addendum, new effective target shade levels were established for 15 AUs (one new AU was split from an existing AU) based on the concept of maximum shading under potential natural vegetation resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation that was partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho’s water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table B.

This addendum to the 2005 approved temperature TMDL re-examined new aerial imagery and assigned new shade targets based on Idaho plant community data. New loads developed in this review should replace 2005 loads. In general, most stream conditions did not change as a result of the new analysis. However, Willow Creek is in worse condition and Beaver Creek is in better condition compared to the original TMDL. All streams examined lack shade to some degree.

Several assessment unit corrections were made during the course of this analysis that resulted from digitizing errors within the hydrography database. A 5th-order segment of Camas Creek had inadvertently been included with a 2nd-order tributaries AU. The segment, formerly identified as AU ID17040220SK018_02 has been reclassified as AU ID17040220SK018_05, a new AU number. Additionally, a 3rd-order segment of Soldier Creek had inadvertently been identified as a 2nd-order segment. The Soldier Creek segment, formerly identified as AU ID17040220SK011_02, is now recognized as AU ID17040220SK011_03. Several small segments of various creeks had alignment problems that required adjusting; however, no new AUs were created for them.

Public Participation

The watershed advisory group (WAG) responsible for the Camas Creek subbasin is the Wood River WAG (see Appendix G for list of members). The WAG was appraised of the Camas Creek TMDL work as it progressed and received a presentation from DEQ on the completed draft on May 10, 2016. The general public was able to comment on this draft document during the public comment period from July 29, 2016 to August 29, 2016 (see Appendix F for responses to public comments).

Table A. Water bodies and pollutants for which TMDLs were developed.

Water Body	Assessment Unit Number	Pollutant(s)
Camas Creek	ID17040220SK001_05 ID17040220SK007_05 ID17040220SK013_05 ID17040220SK018_02 ID17040220SK018_03 ID17040220SK018_04 ID17040220SK018_05 (formerly part of 018_02)	Temperature
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	Temperature
Willow Creek	ID17040220SK003_04	Temperature
Beaver Creek	ID17040220SK004_02 ID17040220SK004_03	Temperature
Soldier Creek	ID17040220SK011_03 (formerly 011_02)	Temperature
Corral Creek	ID17040220SK015_03	Temperature
Wild Horse Creek	ID17040220SK021_03	Temperature

Table B. Summary of assessment outcomes for §303(d)-listed assessment units.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Camas Creek	ID17040220SK001_05 ID17040220SK007_05 ID17040220SK013_05 ID17040220SK018_02 ID17040220SK018_03 ID17040220SK018_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Camas Creek	ID17040220SK018_05 (formerly part of 018_02)	Temperature	Yes	Add to Category 4a	New AU# to replace a mislabeled segment
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Willow Creek	ID17040220SK003_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Beaver Creek	ID17040220SK004_02 ID17040220SK004_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Soldier Creek	ID17040220SK011_03 (formerly 011_02)	Temperature	Yes	Change AU# in Category 4a	Excess solar load from a lack of existing shade
Corral Creek	ID17040220SK015_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Wild Horse Creek	ID17040220SK021_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade

Introduction

This document addresses 7 temperature impaired water bodies (14 assessment units) in the Camas Creek subbasin that have been placed in Category 4a of Idaho's most recent federally approved Integrated Report (DEQ 2014). The purpose of this total maximum daily load (TMDL) addendum is to revise, re-characterize, and document pollutant loads within the Camas Creek subbasin. The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, the Idaho Department of Environmental Quality (DEQ) performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the Camas Creek subbasin. The TMDL (section 5) is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR Part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant. Effective shade targets were established for 15 assessment units (AU) based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures (one new AU was split from an existing AU).

Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements. The federal government, through the United States Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. DEQ implements the Clean Water Act in Idaho, while EPA oversees Idaho and certifies the fulfillment of Clean Water Act requirements and responsibilities.

Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act, in 1972. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 USC §1251). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The Clean Water Act has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to ensure "swimmable and fishable" conditions. These goals relate water quality to more than just chemistry.

The Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to §303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. DEQ must review those standards every 3 years, and EPA must approve Idaho's water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a “§303(d) list”) of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in Idaho’s Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

DEQ monitors waters, and for those not meeting water quality standards, DEQ must establish a TMDL for each pollutant impairing the waters. However, some conditions that impair water quality do not require TMDLs. EPA considers certain unnatural conditions—such as flow alteration, human-caused lack of flow, or habitat alteration—that are not the result of discharging a specific pollutant as “pollution.” TMDLs are not required for water bodies impaired by pollution, rather than a specific pollutant. A TMDL is only required when a pollutant can be identified and in some way quantified.

1 Subbasin Assessment—Subbasin Characterization

The Camas Creek subbasin runs from the headwaters of Camas Creek (west of Packer Butte in the Camas Prairie of Elmore County) to its mouth, where the creek empties into Magic Reservoir. The subbasin lies along the western border of the upper Snake River basin in Idaho, with the Big Wood River and Upper Snake-Rock subbasins surrounding it. The southern border of the Camas Creek subbasin runs from the mouth of Camas Creek in a southwest direction along the southern edge of Macon Flat, then west within the Camas Prairie along the northern edge of the Mount Bennett Hills to the headwaters (Figure 1). From here, the Camas Creek subbasin begins to run in a northeast direction, moving gradually into the Sawtooth National Forest. The northern border runs above Smoky Dome and Cannonball Mountain and then further north along Willow Creek to the Camas County Line. From here, the eastern border runs in a southeast direction along the Camas-Blaine county line, then just south of the Kelly Mountains, continuing southeast to the mouth of Camas Creek. See DEQ (2005a) for a description of physical and cultural attributes of the subbasin.

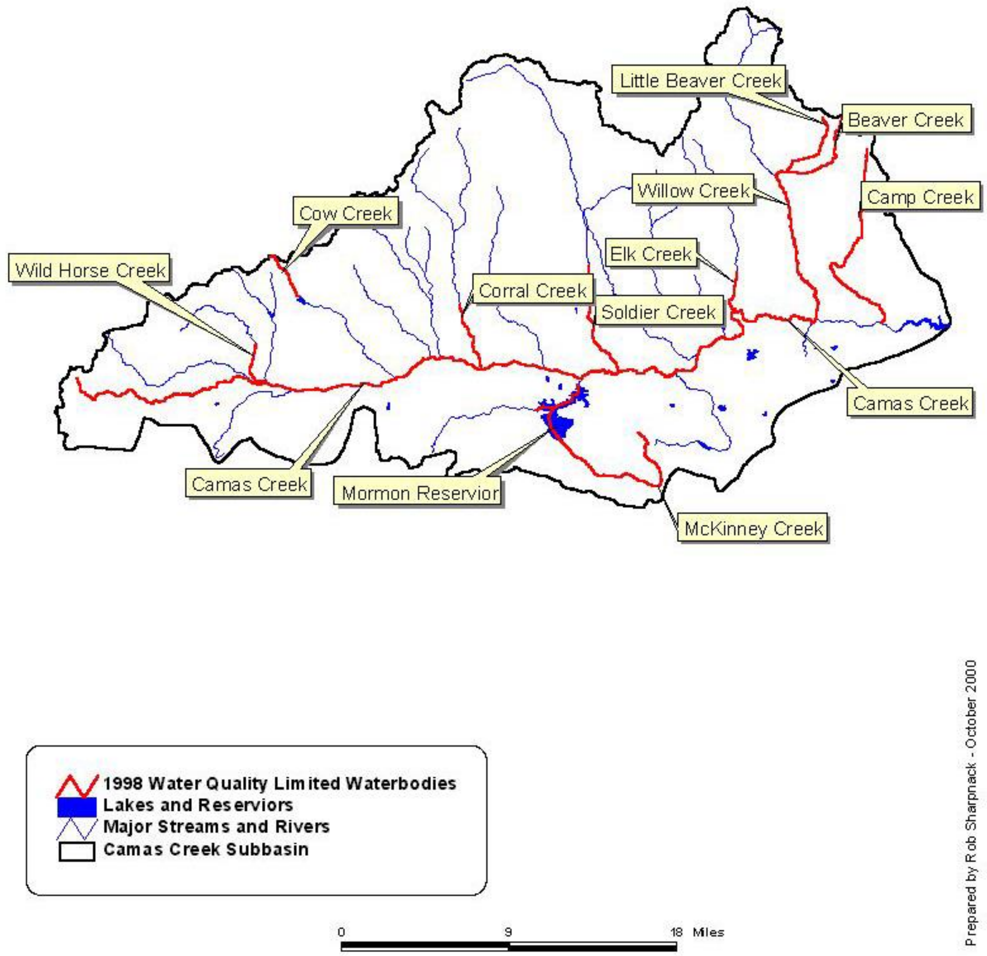

Figure 1. Camas Creek subbasin (image from DEQ 2005a).

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water quality limited. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards.

2.1.1 Assessment Units

AUs are groups of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs—even if ownership and land use change significantly, the AU usually remains the same for the same stream order.

Using AUs to describe water bodies offers many benefits, primarily that all waters of the state are defined consistently. AUs are a subset of water body identification numbers, which relate them directly to the water quality standards.

2.1.2 Listed Waters

Table 1 shows the pollutants listed and the basis for listing for each AU addressed in this addendum. Figure 1 is a map of all impaired assessment units in the subbasin, including those impaired by other causes addressed in the 2005 TMDL.

Table 1. Camas Creek subbasin Category 4a-listed assessment units in the subbasin.

Water Body	Assessment Unit Number	Listed Pollutants	Listing Basis
Camas Creek	ID17060220SK001_05	Temperature	2005 approved TMDL
	ID17060220SK007_05	Temperature	2005 approved TMDL
	ID17060220SK013_05	Temperature	2005 approved TMDL
	ID17060220SK018_02	Temperature	2005 approved TMDL
	ID17060220SK018_03	Temperature	2005 approved TMDL
	ID17060220SK018_04	Temperature	2005 approved TMDL
	ID17060220SK018_05 (formerly part of 018_02)	Temperature	2005 approved TMDL
Camp Creek	ID17060220SK002_02	Temperature	2005 approved TMDL
	ID17060220SK002_03	Temperature	2005 approved TMDL
Willow Creek	ID17060220SK003_04	Temperature	2005 approved TMDL
Beaver Creek	ID17060220SK004_02	Temperature	2005 approved TMDL
	ID17060220SK004_03	Temperature	2005 approved TMDL
Soldier Creek	ID17060220SK011_03 (formerly 011_02)	Temperature	2005 approved TMDL
Corral Creek	ID17060220SK015_03	Temperature	2005 approved TMDL
Wild Horse Creek	ID17060220SK021_03	Temperature	2005 approved TMDL

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as described briefly in Appendix A. The *Water Body Assessment Guidance* (Grafe et al. 2002) provides a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses described in the water quality standards include the following:

- Aquatic life support—cold water, seasonal cold water, warm water, salmonid spawning, and modified
- Contact recreation—primary (e.g., swimming) or secondary (e.g., boating)

- Water supply—domestic, agricultural, and industrial
- Wildlife habitats
- Aesthetics

2.2.1 Beneficial Uses in the Subbasin

The following are beneficial uses originally identified in the 2005 TMDL for the Camas Creek subbasin water bodies addressed by this addendum (DEQ 2005a) (Table 2).

Table 2. Camas Creek subbasin beneficial uses.

Water Body	Beneficial Use	Use Type
Camas Creek	Cold water, salmonid spawning, primary contact recreation	Designated
Wild Horse Creek	Cold water, secondary contact recreation	Presumed
Corral Creek	Cold water, salmonid spawning, secondary contact recreation	Existing
Soldier Creek	Cold water, salmonid spawning, primary contact recreation	Existing
Willow Creek	Cold water, salmonid spawning, primary contact recreation	Existing
Beaver Creek	Cold water, salmonid spawning, secondary contact recreation	Existing
Camp Creek	Cold water, salmonid spawning, secondary contact recreation	Existing

2.2.2 Water Quality Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity, and *narrative* criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251) (Table 3). Although bull trout temperature criteria are listed in Table 3, to our knowledge there are no bull trout within the Camas Creek subbasin. Camas Creek subbasin was not identified as a key watershed for bull trout in Idaho’s Bull Trout Conservation Plan (Batt 1996). For more about temperature criteria and natural background provisions relevant to the PNV approach, see Appendix B.

Table 3. Selected numeric criteria supportive of beneficial uses in Idaho water quality standards.

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
Temperature[b]	—	—	22 °C or less daily maximum; 19 °C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average **Bull Trout**: Not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the 90th percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

DEQ’s procedure to determine whether a water body fully supports beneficial uses is outlined in IDAPA 58.01.02.054. The procedure relies heavily on biological parameters and is presented in detail in the *Water Body Assessment Guidance* (Grafe et al. 2002). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations (Figure 2).

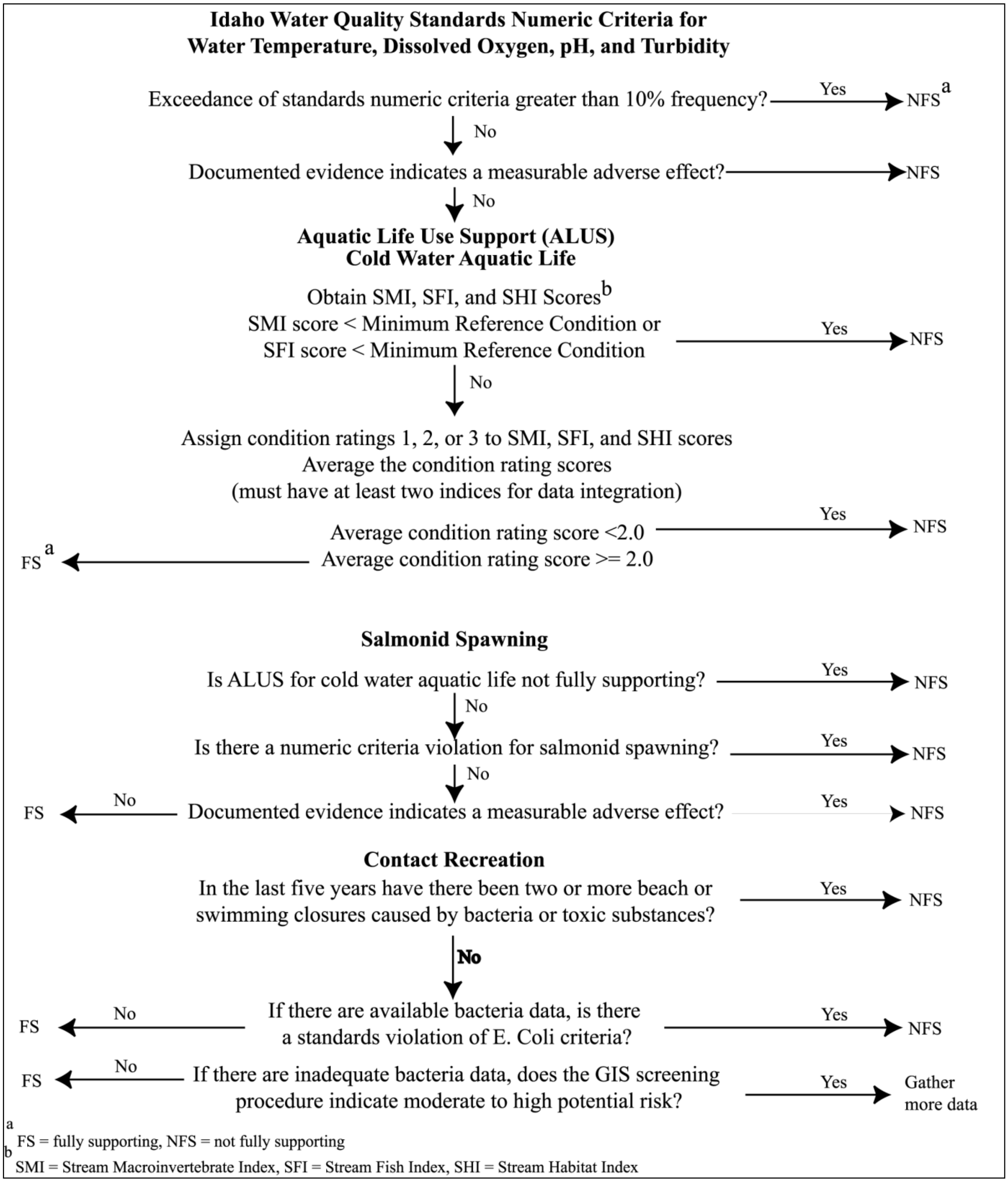

Figure 2. Steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

For a summary of water quality data, see the Camas Creek 5-year review (DEQ 2016). Data sources are listed in Appendix C.

3 Subbasin Assessment—Pollutant Source Inventory

Pollution within the Camas Creek subbasin is primarily from temperature. Load allocations and wasteload allocations were established in the 2005 TMDL (DEQ 2005a).

3.1 Point Sources

There is one point source in the Camas Creek subbasin. As described in the 2005 TMDL (DEQ 2005a), the City of Fairfield Wastewater Treatment Plant discharges its effluent to a ditch that drains into Soldier Creek. Table 4 below was duplicated from the 2005 TMDL. The wasteload allocation is repeated in Section 5.5 of this document.

Table 4. Point sources within the Camas Creek subbasin (Source: DEQ 2005a).

	City of Fairfield
NPDES permit no.	ID 002438-4
First discharge	Jan. 1, 1976
Receiving water	Camas Creek through unnamed ditch to Soldier Creek
Discharge period	March 1 to June 30
Facility type	Lagoons and rapid infiltration basin
Discharge restrictions	Inflow must be ten times greater than the discharge
Design Flow	0.165 mgd

[a]Data collected from NPDES files in DEQ Twin Falls office.

3.2 Nonpoint Sources

Because this TMDL is based on PNV-style riparian shade calculations, which are equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment specific and dependent on the target load for a given segment. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent on background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

3.3 Pollutant Transport

Pollutant transport refers to the pathway by which pollutants move from the pollutant source to cause a problem or water quality violation in the receiving water body. In PNV-style temperature TMDLs where riparian shade is the driving force for thermal pollution, pollutants are essentially generated at the stream margin.

4 Subbasin Assessment—Summary of Past and Present Pollution Control Efforts

Recent water quality monitoring, including temperature, are described in detail for each AU within the subbasin in the Camas Creek 5-year review (DEQ 2016).

5 Total Maximum Daily Loads

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control. Because of uncertainties about quantifying loads and the relation of specific loads to attaining water quality standards, the rules regarding TMDLs (40 CFR Part 130) require a margin of safety be included in the TMDL. Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources.

Load capacity can be summarized by the following equation:

$$LC = MOS + NB + LA + WLA = TMDL$$

Where:

LC = load capacity
MOS = margin of safety
NB = natural background
LA = load allocation
WLA = wasteload allocation

The equation is written in this order because it represents the logical order in which a load analysis is conducted. First, the load capacity is determined. Then the load capacity is broken down into its components. After the necessary margin of safety and natural background, if relevant, are quantified, the remainder is allocated among pollutant sources (i.e., the load allocation and wasteload allocation). When the breakdown and allocation are complete, the result is a TMDL, which must equal the load capacity.

The load capacity must be based on critical conditions—the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may initially appear.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary (40 CFR 130.2). These other measures must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as temperature, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the Camas Creek subbasin temperature TMDLs, we used a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLS, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. See Appendix B for further discussion of water quality standards and natural background provisions.

The PNV approach is described briefly below. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in detail in *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009). The manual also provides a more complete discussion of shade and its effects on stream water temperature.

5.1.1 Factors Controlling Water Temperature in Streams

There are several important contributors of heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most controllable. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology (i.e., structure) affects riparian vegetation density and water storage in the alluvial aquifer. Riparian vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. We can measure the amount of shade that a stream receives in a number of ways. Effective shade (i.e., that shade provided by all objects that intercept the sun as it makes its way across the sky) can be measured in a given location with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and stream aspect.

In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer or estimated visually either on-site or using aerial photography. All of these methods provide information about how much of the stream is covered and how much is exposed to direct solar radiation.

5.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

We can estimate PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities), and we can measure or estimate existing canopy cover or shade. Comparing the two (target and existing shade) tells us how much excess solar load the stream is receiving and what potential exists to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, we used an average of the Boise and Pocatello stations. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (see Appendix B).

PNV shade and the associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as no other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for 15 AUs from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

Visual estimates made from aerial photos are strongly influenced by canopy cover and do not always take into account topography or any shading that may occur from physical features other than vegetation. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. However, research has shown that shade and canopy cover measurements are remarkably similar (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade. The visual estimates of shade in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at nine sites. The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun’s path covered by these objects is the effective shade on the stream at the location where the tracing is made. To adequately characterize the effective shade on a stream segment, ten traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bank-full water level. Ten traces were taken following the manufacturer’s instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 50 to 100 meters (m) from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 m, 50 paces, etc.). Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

When possible, the sampler also measured bank-full widths, took notes, and photographed the landscape of the stream at several unique locations while taking traces. Special attention was given to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade-producing ones) were present. One can also take densiometer readings at the same location as Solar Pathfinder traces. These readings provide the potential to develop relationships between canopy cover and effective shade for a given stream.

The results of the Solar Pathfinder field verification analysis showed that in general, our first aerial photo interpretation over-estimated existing shade by about two 10% intervals (Table 5). The average difference between aerial class and Solar Pathfinder readings was 13% ± 8.6% (average ± 95% confidence interval). Three of the nine sites showed accurate interpretations, two sites were over-estimated by one 10% class, three sites were over-estimated by two 10% classes, and one site was off by four classes. These results were used to correct the first aerial interpretation of existing shade at the Solar Pathfinder locations and calibrate our eyes for a second aerial interpretation of all waters in the analysis.

Table 5. Solar Pathfinder results for the Camas Creek subbasin.

aerial class	pathfinder actual	pathfinder class	delta	Site Name
70	34.3	30	40	Beaver 1
80	66.1	60	20	Little Beaver 1
30	21.4	20	10	Camp 1
60	61.1	60	0	Camp 2a
50	33.4	30	20	Camp 2b
60	51.2	50	10	Camp 3
0	1.4	0	0	Camas 1
0	2.5	0	0	Camas 2
40	28.8	20	20	Willow 1
			13	average
			13.23	std dev
			8.64	95%CI

5.1.2.2 Target Shade Determination

PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities in Idaho (see Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

Natural Bank-Full Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bank-full width is used because it best approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bank-full width may not reflect widths present under PNV (i.e., natural widths). As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallower. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

Since, existing bank-full width may not be discernible from aerial photo interpretation and may not reflect natural bank-full widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bank-full width (Figure 3).

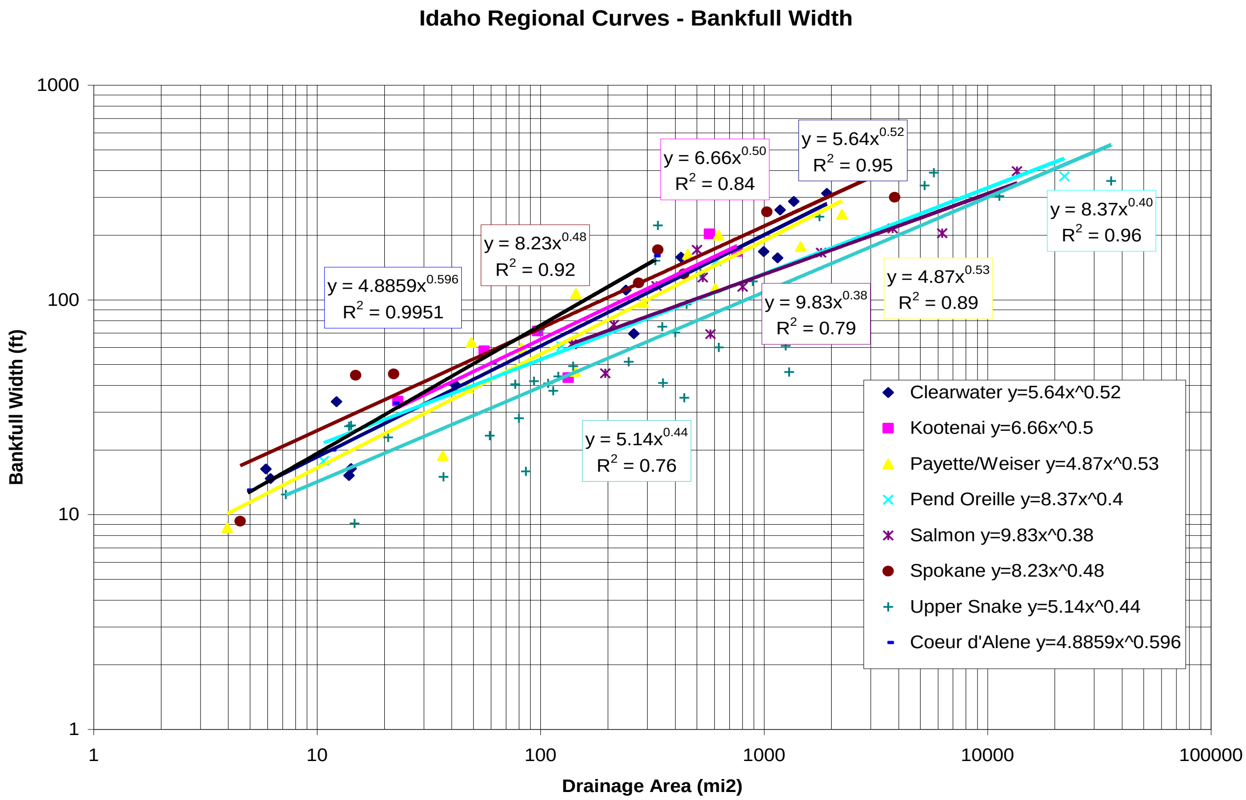

Figure 3. Bank-full width as a function of drainage area.

For each stream evaluated in the load analysis, natural bank-full width was estimated based on the drainage area of the Upper Snake Basin curve from Figure 3. Although estimates from other curves were examined (i.e., Salmon, Payette/Weiser), the Upper Snake curve was ultimately chosen because of its proximity to the Camas Creek subbasin and similarities in geology and climate. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for the Camas Creek subbasin, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bank-full width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

In general, we found BURP bank-full width data to agree with natural bank-full width estimates from the Upper Snake basin curve and chose not to make natural widths any smaller than these Upper Snake Basin estimates. Natural bank-full width estimates for each stream in this analysis are presented in Table 6. The load analysis tables contain a natural bank-full width and an existing bank-full width for every stream segment in the analysis based on the bank-full width results presented in Table 6. Existing widths and natural widths are the same in load tables when no data support making them differ.

Table 6. Bank-full width calculations for the Camas Creek subbasin.

Location	area (sq mi)	US (m)	Salm (m)	P/W (m)	measured channel (year)	Comments
Camp Cr @ mouth	26.8	7	10	8		
Camp Cr ab Brush Cr	13.1	5	8	6	4m (1996), dry (2011)	
Camp Cr ab un-named tributary	6.9	4	6	4	2.7m (2011)	below Eagle Creek
Camp Cr bl Jumbo Canyon	2.46	2	4	2	3m (1996)	
Jumbo Canyon @ mouth	1.01	2	3	1		
Eagle Cr @ mouth	1.64	2	4	2		
un-named tributary @ mouth	2.56	2	4	2		
Flat Cr @ mouth	2.16	2	4	2		
Brush Cr @ mouth	2.64	2	4	2		
Spare Cr @ mouth	2.43	2	4	2	dry (2007)	
Shirley Springs creek @ mouth	2.15	2	4	2		
Beaver Cr @ mouth	11.1	5	7	5	2.8m (1997)	beaver ponds
Beaver Cr ab Little Beaver Cr	5.5	3	6	4	4.6m (1993), 2m (1997), 1.8m (2011)	
Beaver Cr bl 1st tributary	2.11	2	4	2		
1st tributary to Beaver Cr	0.93	2	3	1		
Little Beaver Cr @ mouth	5	3	6	3	1.5m (97), 1.3m (01), 1.6m (11), 2.9m (04)	
Little Beaver Cr ab tributary	1.85	2	4	2	4m (1995)	
tributary to Little Beaver Cr	1.4	2	3	2		
Willow Cr @ mouth	63.7	10	15	13	5.8m (2011)	
Willow Cr bl Beaver Cr	48.2	9	13	12		
Soldier Cr @ mouth	62.7	10	14	13		
Soldier Cr @ Hwy 20	49.7	9	13	12	10.3m (1995)	1mile south of Hwy 20
Soldier Cr @ top of AU	40.5	8	12	11		
Corral Cr @ mouth	25.6	7	10	8	10m (1993)	
Corral Cr bl EF/WF confluence	19.2	6	9	7		
Wild Horse Cr @ mouth	16.9	5	9	7	10m (1993)	
Wild Horse Cr @ top of AU	9.8	4	7	5	dry (1996)	
Camas Cr @ Magic Reservoir	666.1	27	35	47	14.5m (1995), 11.7m (2011)	below Willow Creek
Camas Cr ab Willow Cr	562	25	33	43	16.8m (1995), no flow(2007), dry (2010)	above Deer Creek
Camas Cr ab Soldier Cr	346.9	21	28	33	25.9m (1993), 21.9m (1995), dry (2001)	above Morman Res.
Camas Cr bl Corral Cr	208.5	16	23	25	14.2m (1995)	above Corral Creek
Camas Cr ab Malad River	27.6	7	11	9	7m (1994)	

Note: US = Upper Snake Basin, Salm = Salmon Basin, P/W = Payette/Weiser Basin.

Design Conditions

Camas Creek is located on the Camas Prairie, a level 4 sub-ecoregion within the Snake River Plains Level 3 Ecoregion of McGrath et al. (2001). The Camas Prairie is a cold, wet valley used for small grains, alfalfa, pasture, and range agriculture as well as wildlife refuge. The seasonally wet soils are prone to localized flooding. Wet bottomlands support grasses and sedges while alluvial fans and terraces support grasses and sagebrush. Riparian areas tend to be either willow or grass dominated.

Most tributaries to Camas Creek originate in northern mountains and hills that are a part of the Idaho Batholith Level 3 Ecoregion. Immediately above the prairie is the Foothill Shrublands and Grasslands Level 4 Sub-ecoregion. These hills and benches are dry, treeless, and covered with shrubs and grasses. Further north is the Dry, Partly Wooded Mountains Level 4 Sub-ecoregion, where sedimentary and extrusive rocks maintain a mosaic of shrubland, open Douglas-fir forest, and aspen. The very headwaters of tributaries may extend into the Southern Forested Mountains Level 4 Sub-ecoregion, which contains droughty soils from granitic rocks. Open Douglas-fir forests are common, with grand fir and subalpine fir in higher elevations, ponderosa pine in canyons, and mountain sagebrush patches. Riparian areas tend to be dominated by shrubs (willow or alder).

Shade Curve Selection

To determine PNV shade targets for the Camas Creek subbasin, effective shade curves from the Southwest Idaho Forest Ecogroup and Southern Idaho Non-Forest vegetation types were examined (Shumar and De Varona 2009). These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For the Camas Creek subbasin, curves for the most similar vegetation type were selected for shade target determinations (Table 7).

Most streams examined occur in deciduous shrub vegetation types. We used Geyer willow and alder vegetation types predominantly in the mid to higher elevations and sandbar willow and grass vegetation types in lower regions on the Camas Prairie. Although higher elevations reached forest sections of the ecoregion, only Beaver Creek in this analysis actually encounters forest (in this case open Douglas-fir forest) riparian vegetation. Cottonwood vegetation was encountered in a few areas of the Camp Creek watershed, and yellow willow was chosen to represent the lower elevation willow type on the Shirley Springs tributary.

Table 7. Shade curves used to derive shade targets in the Camas Creek subbasin.

Southwest Idaho Forest Ecogroup Type	Southern Idaho Non-Forest Types
PVG 4—cool, dry Douglas-fir	Mountain alder (*Alnus tenuifolia*)
	Black cottonwood (*Populus trichocarpa*)
	Geyer willow (*Salix geyeriana*)
	Sandbar willow (*Salix exigua*)
	Yellow willow (*Salix lutea*)
	Graminoid (grass)

5.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the segments within that stream. These loads are determined by multiplying the solar load measured by a flat-plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., the percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), the solar load hitting the stream under that target is 40% of the load hitting the flat-plate collector under full sun.

We obtained solar load data from flat-plate collectors at the NREL weather stations in Boise and Pocatello, Idaho. The solar load data used in this TMDL analysis are spring/summer averages (i.e., an average load for the 6-month period from April through September). As such, load capacity calculations are also based on this 6-month period, which coincides with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and spawning is occurring. During this period, temperatures may affect beneficial uses; spring and fall salmonid spawning and cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall.

Table 8–Table 22 and Figure 4 (and C-1, C-4, C-7, C-10, and C-13 in Appendix C) show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and kWh/day) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. Because load calculations involve stream segment area calculations, the segment's channel width, which typically only has one or two significant figures, dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors. The AU with the largest target load (i.e., load capacity) was Camas Creek (ID17040220SK001_05) with 2.5 million kWh/day (Table 16). The smallest target load was in the Camas Creek AU (ID17040220SK018_02) with 11,000 kWh/day (Table 10).

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (40 CFR §130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed) but may be aggregated by type of source or area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from the field-verified aerial photo interpretations. There is currently one permitted point source in the affected AUs. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather stations. Existing shade data are presented in Table 8–Table 22 and Figure 5 (and C-2, C-5, C-8, C-11, C-14 in Appendix C). Like load capacities (target loads), existing loads in Table 8–Table 22 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. Should existing load exceed target load, this difference becomes the excess load (i.e., shade deficit) to be discussed next in the load allocation section and as depicted in the shade deficit figures (Figure 6 and Figures C-3, C-6, C-9, C-12, and C-15 in Appendix C). The AU with the largest existing load was Camas Creek (ID17040220SK001_05) with 2.8 million kWh/day (Table 16). The smallest existing load was in the Camas Creek AU (D17040220SK018_02) with 12,000 kWh/day (Table 10).

Note: All assessment unit (AU) numbers start with ID17040220SK in all load tables (Table 8–Table 22). Significant figures are controlled by the lowest level in the calculation, typically that of the channel width. Some rounding errors may result.

Table 8. Existing and target solar loads for the Beaver Creek watershed (AU ID17040220SK004_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	Beaver Creek	1	1100	PVG 4	96%	0.25	1	1,000	300	90%	0.63	1	1,000	600	300	-6%
004_02	Beaver Creek	2	1400	Geyer willow	92%	0.50	1	1,000	500	90%	0.63	1	1,000	600	100	-2%
004_02	Beaver Creek	3	240	alder	91%	0.56	1	200	100	80%	1.25	1	200	300	200	-11%
004_02	Beaver Creek	4	370	Geyer willow	78%	1.38	2	700	1,000	90%	0.63	2	700	400	(600)	0%
004_02	Beaver Creek	5	270	Geyer willow	78%	1.38	2	500	700	60%	2.51	2	500	1,000	300	-18%
004_02	Beaver Creek	6	1100	PVG 4	95%	0.31	2	2,000	600	90%	0.63	2	2,000	1,000	400	-5%
004_02	Beaver Creek	7	670	alder	86%	0.88	2	1,000	900	80%	1.25	2	1,000	1,000	100	-6%
004_02	Beaver Creek	8	2100	alder	72%	1.76	3	6,000	10,000	70%	1.88	3	6,000	10,000	0	-2%
004_02	Beaver Creek	9	230	Geyer willow	61%	2.45	3	700	2,000	30%	4.39	3	700	3,000	1,000	-31%
004_02	Beaver Creek	10	640	Geyer willow	61%	2.45	3	2,000	5,000	40%	3.76	3	2,000	8,000	3,000	-21%
004_02	Beaver Creek	11	260	Geyer willow	61%	2.45	3	800	2,000	30%	4.39	3	800	4,000	2,000	-31%
004_02	trib to Beaver Cr	1	250	Geyer willow	92%	0.50	1	300	200	90%	0.63	1	300	200	0	-2%
004_02	trib to Beaver Cr	2	400	Geyer willow	92%	0.50	1	400	200	70%	1.88	1	400	800	600	-22%
004_02	trib to Beaver Cr	3	1200	alder	86%	0.88	2	2,000	2,000	80%	1.25	2	2,000	3,000	1,000	-6%
004_02	Little Beaver Creek	1	390	Geyer willow	92%	0.50	1	400	200	60%	2.51	1	400	1,000	800	-32%
004_02	Little Beaver Creek	2	480	Geyer willow	92%	0.50	1	500	300	90%	0.63	1	500	300	0	-2%
004_02	Little Beaver Creek	3	140	Geyer willow	92%	0.50	1	100	50	50%	3.14	1	100	300	300	-42%
004_02	Little Beaver Creek	4	740	alder	91%	0.56	1	700	400	90%	0.63	1	700	400	0	-1%
004_02	Little Beaver Creek	5	120	Geyer willow	92%	0.50	1	100	50	50%	3.14	1	100	300	300	-42%
004_02	Little Beaver Creek	6	1200	Geyer willow	78%	1.38	2	2,000	3,000	90%	0.63	2	2,000	1,000	(2,000)	0%
004_02	Little Beaver Creek	7	160	Geyer willow	78%	1.38	2	300	400	50%	3.14	2	300	900	500	-28%
004_02	Little Beaver Creek	8	1200	Geyer willow	78%	1.38	2	2,000	3,000	70%	1.88	2	2,000	4,000	1,000	-8%
004_02	Little Beaver Creek	9	570	Geyer willow	61%	2.45	3	2,000	5,000	20%	5.02	3	2,000	10,000	5,000	-41%
004_02	Little Beaver Creek	10	330	Geyer willow	61%	2.45	3	1,000	2,000	60%	2.51	3	1,000	3,000	1,000	-1%
004_02	Little Beaver Creek	11	270	Geyer willow	61%	2.45	3	800	2,000	0%	6.27	3	800	5,000	3,000	-61%
004_02	Little Beaver Creek	12	81	Geyer willow	61%	2.45	3	200	500	30%	4.39	3	200	900	400	-31%
004_02	Little Beaver Creek	13	150	Geyer willow	61%	2.45	3	500	1,000	0%	6.27	3	500	3,000	2,000	-61%
004_02	Little Beaver Creek	14	250	Geyer willow	61%	2.45	3	800	2,000	30%	4.39	3	800	4,000	2,000	-31%
004_02	Little Beaver Creek	15	270	Geyer willow	61%	2.45	3	800	2,000	40%	3.76	3	800	3,000	1,000	-21%
004_02	Little Beaver Creek	16	490	Geyer willow	61%	2.45	3	1,000	2,000	60%	2.51	3	1,000	3,000	1,000	-1%
004_02	1st to Little Beaver	1	1300	Geyer willow	92%	0.50	1	1,000	500	80%	1.25	1	1,000	1,000	500	-12%
004_02	1st to Little Beaver	2	190	alder	91%	0.56	1	200	100	90%	0.63	1	200	100	0	-1%
004_02	1st to Little Beaver	3	790	Geyer willow	78%	1.38	2	2,000	3,000	80%	1.25	2	2,000	3,000	0	0%
004_02	1st to Little Beaver	4	790	Geyer willow	78%	1.38	2	2,000	3,000	90%	0.63	2	2,000	1,000	(2,000)	0%
							Totals		56,000					79,000	23,000	

Table 9. Existing and target solar loads for the Beaver Creek watershed (AU ID17040220SK004_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_03	Beaver Creek	1	470	Geyer willow	43%	3.57	5	2,000	7,000	30%	4.39	5	2,000	9,000	2,000	-13%
004_03	Beaver Creek	2	700	Geyer willow	43%	3.57	5	4,000	10,000	50%	3.14	5	4,000	10,000	0	0%
							Totals		17,000					19,000	2,000	

Table 10. Existing and target solar loads for Camas Creek (AU ID17040220SK018_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_02	Camas Creek	1	410	Geyer willow	61%	2.45	3	1,000	2,000	70%	1.88	3	1,000	2,000	0	0%
018_02	Camas Creek	2	200	Geyer willow	61%	2.45	3	600	1,000	0%	6.27	3	600	4,000	3,000	-61%
018_02	Camas Creek	3	210	Geyer willow	61%	2.45	3	600	1,000	50%	3.14	3	600	2,000	1,000	-11%
018_02	Camas Creek	4	1100	Geyer willow	61%	2.45	3	3,000	7,000	80%	1.25	3	3,000	4,000	(3,000)	0%
							Totals		11,000					12,000	1,000	

Table 11. Existing and target solar loads for Camas Creek (AU ID17040220SK018_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_03	Camas Creek	1	880	sandbar willow	58%	2.63	4	4,000	10,000	50%	3.14	4	4,000	10,000	0	-8%
018_03	Camas Creek	2	480	sandbar willow	58%	2.63	4	2,000	5,000	30%	4.39	4	2,000	9,000	4,000	-28%
018_03	Camas Creek	3	1400	sandbar willow	58%	2.63	4	6,000	20,000	50%	3.14	4	6,000	20,000	0	-8%
018_03	Camas Creek	4	400	sandbar willow	58%	2.63	4	2,000	5,000	30%	4.39	4	2,000	9,000	4,000	-28%
018_03	Camas Creek	5	820	sandbar willow	58%	2.63	4	3,000	8,000	50%	3.14	4	3,000	9,000	1,000	-8%
018_03	Camas Creek	6	720	sandbar willow	50%	3.14	5	4,000	10,000	30%	4.39	5	4,000	20,000	10,000	-20%
018_03	Camas Creek	7	330	sandbar willow	50%	3.14	5	2,000	6,000	50%	3.14	5	2,000	6,000	0	0%
018_03	Camas Creek	8	130	sandbar willow	50%	3.14	5	700	2,000	20%	5.02	5	700	4,000	2,000	-30%
018_03	Camas Creek	9	200	sandbar willow	50%	3.14	5	1,000	3,000	0%	6.27	5	1,000	6,000	3,000	-50%
018_03	Camas Creek	10	150	sandbar willow	50%	3.14	5	800	3,000	10%	5.64	5	800	5,000	2,000	-40%
018_03	Camas Creek	11	250	sandbar willow	50%	3.14	5	1,000	3,000	0%	6.27	5	1,000	6,000	3,000	-50%
018_03	Camas Creek	12	140	sandbar willow	50%	3.14	5	700	2,000	10%	5.64	5	700	4,000	2,000	-40%
018_03	Camas Creek	13	490	sandbar willow	50%	3.14	5	2,000	6,000	0%	6.27	5	2,000	10,000	4,000	-50%
018_03	Camas Creek	14	260	sandbar willow	50%	3.14	5	1,000	3,000	20%	5.02	5	1,000	5,000	2,000	-30%
018_03	Camas Creek	15	230	sandbar willow	50%	3.14	5	1,000	3,000	0%	6.27	5	1,000	6,000	3,000	-50%
018_03	Camas Creek	16	290	sandbar willow	50%	3.14	5	1,000	3,000	10%	5.64	5	1,000	6,000	3,000	-40%
018_03	Camas Creek	17	520	sandbar willow	50%	3.14	5	3,000	9,000	0%	6.27	5	3,000	20,000	10,000	-50%
018_03	Camas Creek	18	520	sandbar willow	44%	3.51	6	3,000	10,000	40%	3.76	6	3,000	10,000	0	-4%
018_03	Camas Creek	19	130	sandbar willow	44%	3.51	6	800	3,000	20%	5.02	6	800	4,000	1,000	-24%
018_03	Camas Creek	20	320	sandbar willow	44%	3.51	6	2,000	7,000	0%	6.27	6	2,000	10,000	3,000	-44%
018_03	Camas Creek	21	1300	sandbar willow	44%	3.51	6	8,000	30,000	30%	4.39	6	8,000	40,000	10,000	-14%
018_03	Camas Creek	22	160	sandbar willow	44%	3.51	6	1,000	4,000	60%	2.51	6	1,000	3,000	(1,000)	0%
018_03	Camas Creek	23	410	sandbar willow	44%	3.51	6	2,000	7,000	30%	4.39	6	2,000	9,000	2,000	-14%
018_03	Camas Creek	24	320	sandbar willow	44%	3.51	6	2,000	7,000	50%	3.14	6	2,000	6,000	(1,000)	0%
018_03	Camas Creek	25	300	sandbar willow	44%	3.51	6	2,000	7,000	10%	5.64	6	2,000	10,000	3,000	-34%
018_03	Camas Creek	26	3600	sandbar willow	39%	3.82	7	30,000	100,000	0%	6.27	7	30,000	200,000	100,000	-39%
018_03	Camas Creek	27	820	sandbar willow	39%	3.82	7	6,000	20,000	10%	5.64	7	6,000	30,000	10,000	-29%
							Totals		300,000					480,000	180,000	

Table 12. Existing and target solar loads for Camas Creek (AU ID17040220SK018_04).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_04	Camas Creek	1	520	sandbar willow	35%	4.08	8	4,000	20,000	0%	6.27	8	4,000	30,000	10,000	-35%
018_04	Camas Creek	2	1300	sandbar willow	35%	4.08	8	10,000	40,000	30%	4.39	8	10,000	40,000	0	-5%
018_04	Camas Creek	3	800	sandbar willow	35%	4.08	8	6,000	20,000	0%	6.27	8	6,000	40,000	20,000	-35%
018_04	Camas Creek	4	1200	sandbar willow	32%	4.26	9	10,000	40,000	0%	6.27	9	10,000	60,000	20,000	-32%
018_04	Camas Creek	5	320	sandbar willow	32%	4.26	9	3,000	10,000	30%	4.39	9	3,000	10,000	0	-2%
018_04	Camas Creek	6	680	sandbar willow	32%	4.26	9	6,000	30,000	0%	6.27	9	6,000	40,000	10,000	-32%
018_04	Camas Creek	6	1300	grass	7%	5.83	9	10,000	60,000	0%	6.27	9	10,000	60,000	0	-7%
018_04	Camas Creek	7	1800	sandbar willow	29%	4.45	10	18,000	80,000	0%	6.27	10	18,000	110,000	30,000	-29%
018_04	Camas Creek	7	5600	grass	7%	5.83	10	56,000	330,000	0%	6.27	10	56,000	350,000	20,000	-7%
018_04	Camas Creek	8	790	sandbar willow	27%	4.58	11	8,700	40,000	0%	6.27	11	8,700	55,000	15,000	-27%
							Totals		670,000					800,000	130,000	

Table 13. Existing and target solar loads for Camas Creek (AU ID17040220SK018_05), formerly part of 018_02.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_05	Camas Creek	1	550	sandbar willow	25%	4.70	12	6,600	31,000	10%	5.64	12	6,600	37,000	6,000	-15%
018_05	Camas Creek	2	1700	sandbar willow	25%	4.70	12	20,000	94,000	30%	4.39	12	20,000	88,000	(6,000)	0%
018_05	Camas Creek	3	1900	sandbar willow	23%	4.83	13	25,000	120,000	30%	4.39	13	25,000	110,000	(10,000)	0%
018_05	Camas Creek	4	490	sandbar willow	23%	4.83	13	6,400	31,000	0%	6.27	13	6,400	40,000	9,000	-23%
018_05	Camas Creek	5	740	sandbar willow	23%	4.83	13	9,600	46,000	10%	5.64	13	9,600	54,000	8,000	-13%
018_05	Camas Creek	6	3400	sandbar willow	21%	4.95	14	48,000	240,000	0%	6.27	14	48,000	300,000	60,000	-21%
018_05	Camas Creek	8	400	sandbar willow	21%	4.95	14	5,600	28,000	10%	5.64	14	5,600	32,000	4,000	-11%
018_05	Camas Creek	9	1200	sandbar willow	21%	4.95	14	17,000	84,000	0%	6.27	14	17,000	110,000	26,000	-21%
							Totals		670,000					770,000	97,000	

Table 14. Existing and target solar loads for Camas Creek (AU ID17040220SK013_05).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
013_05	Camas Creek	1	1500	sandbar willow	19%	5.08	16	24,000	120,000	0%	6.27	16	24,000	150,000	30,000	-19%
013_05	Camas Creek	2	210	sandbar willow	19%	5.08	16	3,400	17,000	10%	5.64	16	3,400	19,000	2,000	-9%
013_05	Camas Creek	3	870	sandbar willow	19%	5.08	16	14,000	71,000	0%	6.27	16	14,000	88,000	17,000	-19%
013_05	Camas Creek	4	210	sandbar willow	32%	4.26	9	2,000	9,000	20%	5.02	9	2,000	10,000	1,000	-12%
013_05	Camas Creek	5	490	sandbar willow	32%	4.26	9	4,000	20,000	30%	4.39	9	4,000	20,000	0	-2%
013_05	Camas Creek	6	260	sandbar willow	32%	4.26	9	2,000	9,000	0%	6.27	9	2,000	10,000	1,000	-32%
013_05	Camas Creek	7	570	sandbar willow	32%	4.26	9	5,000	20,000	30%	4.39	9	5,000	20,000	0	-2%
013_05	Camas Creek	8	110	sandbar willow	32%	4.26	9	1,000	4,000	0%	6.27	9	1,000	6,000	2,000	-32%
013_05	Camas Creek	9	450	sandbar willow	32%	4.26	9	4,000	20,000	30%	4.39	9	4,000	20,000	0	-2%
013_05	Camas Creek	10	3000	sandbar willow	32%	4.26	9	30,000	100,000	0%	6.27	9	30,000	200,000	100,000	-32%
013_05	Camas Creek	11	760	sandbar willow	32%	4.26	9	7,000	30,000	30%	4.39	9	7,000	30,000	0	-2%
013_05	Camas Creek	12	2100	sandbar willow	17%	5.20	18	38,000	200,000	20%	5.02	18	38,000	190,000	(10,000)	0%
013_05	Camas Creek	13	4600	sandbar willow	15%	5.33	20	92,000	490,000	0%	6.27	20	92,000	580,000	90,000	-15%
013_05	Camas Creek	14	510	sandbar willow	15%	5.33	21	11,000	59,000	10%	5.64	21	11,000	62,000	3,000	-5%
013_05	Camas Creek	15	2800	sandbar willow	15%	5.33	21	59,000	310,000	20%	5.02	21	59,000	300,000	(10,000)	0%
							Totals		1,500,000					1,700,000	230,000	

Table 15. Existing and target solar loads for Camas Creek (AU ID17040220SK007_05).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
007_05	Camas Creek	1	690	sandbar willow	27%	4.58	11	7,600	35,000	20%	5.02	11	7,600	38,000	3,000	-7%
007_05	Camas Creek	2	660	sandbar willow	27%	4.58	11	7,300	33,000	10%	5.64	11	7,300	41,000	8,000	-17%
007_05	Camas Creek	3	380	sandbar willow	27%	4.58	11	4,200	19,000	40%	3.76	11	4,200	16,000	(3,000)	0%
007_05	Camas Creek	4	510	sandbar willow	27%	4.58	11	5,600	26,000	30%	4.39	11	5,600	25,000	(1,000)	0%
007_05	Camas Creek	5	550	sandbar willow	27%	4.58	11	6,100	28,000	0%	6.27	11	6,100	38,000	10,000	-27%
007_05	Camas Creek	6	770	sandbar willow	27%	4.58	11	8,500	39,000	20%	5.02	11	8,500	43,000	4,000	-7%
007_05	Camas Creek	7	410	sandbar willow	27%	4.58	11	4,500	21,000	40%	3.76	11	4,500	17,000	(4,000)	0%
007_05	Camas Creek	8	750	sandbar willow	27%	4.58	11	8,300	38,000	10%	5.64	11	8,300	47,000	9,000	-17%
007_05	Camas Creek	9	240	sandbar willow	27%	4.58	11	2,600	12,000	0%	6.27	11	2,600	16,000	4,000	-27%
007_05	Camas Creek	10	1000	sandbar willow	27%	4.58	11	11,000	50,000	20%	5.02	11	11,000	55,000	5,000	-7%
007_05	Camas Creek	11	800	sandbar willow	27%	4.58	11	8,800	40,000	40%	3.76	11	8,800	33,000	(7,000)	0%
007_05	Camas Creek	12	5500	sandbar willow	27%	4.58	11	61,000	280,000	10%	5.64	11	61,000	340,000	60,000	-17%
007_05	Camas Creek	13	65	sandbar willow	27%	4.58	11	720	3,300	0%	6.27	11	720	4,500	1,200	-27%
007_05	Camas Creek	14	1300	sandbar willow	13%	5.45	23	30,000	160,000	0%	6.27	23	30,000	190,000	30,000	-13%
007_05	Camas Creek	15	6200	sandbar willow	13%	5.45	24	150,000	820,000	0%	6.27	24	150,000	940,000	120,000	-13%
007_05	Camas Creek	16	4800	sandbar willow	12%	5.52	25	120,000	660,000	0%	6.27	25	120,000	750,000	90,000	-12%
							Totals		2,300,000					2,600,000	330,000	

Table 16. Existing and target solar loads for Camas Creek (AU ID17040220SK001_05).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
001_05	Camas Creek	1	6030	sandbar willow	12%	5.52	25	150,000	830,000	0%	6.27	25	150,000	940,000	110,000	-12%
001_05	Camas Creek	2	5370	sandbar willow	12%	5.52	26	140,000	770,000	0%	6.27	26	140,000	880,000	110,000	-12%
001_05	Camas Creek	3	1250	sandbar willow	12%	5.52	27	34,000	190,000	10%	5.64	27	34,000	190,000	0	-2%
001_05	Camas Creek	4	1700	sandbar willow	12%	5.52	27	46,000	250,000	0%	6.27	27	46,000	290,000	40,000	-12%
001_05	Camas Creek	5	1100	sandbar willow	12%	5.52	27	30,000	170,000	10%	5.64	27	30,000	170,000	0	-2%
001_05	Camas Creek	6	2000	sandbar willow	12%	5.52	27	54,000	300,000	0%	6.27	27	54,000	340,000	40,000	-12%
							Totals		2,500,000					2,800,000	300,000	

Table 17. Existing and target solar loads for the Camp Creek watershed (AU ID17040220SK002_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_02	Camp Creek	1	1000	alder	91%	0.56	1	1,000	600	90%	0.63	1	1,000	600	0	-1%
002_02	Camp Creek	2	530	Geyer willow	92%	0.50	1	500	300	90%	0.63	1	500	300	0	-2%
002_02	Camp Creek	3	640	alder	91%	0.56	1	600	300	80%	1.25	1	600	800	500	-11%
002_02	Camp Creek	4	93	Geyer willow	92%	0.50	1	90	50	90%	0.63	1	90	60	10	-2%
002_02	Camp Creek	5	350	Geyer willow	78%	1.38	2	700	1,000	90%	0.63	2	700	400	(600)	0%
002_02	Camp Creek	6	130	Geyer willow	78%	1.38	2	300	400	50%	3.14	2	300	900	500	-28%
002_02	Camp Creek	7	110	Geyer willow	78%	1.38	2	200	300	90%	0.63	2	200	100	(200)	0%
002_02	Camp Creek	8	210	Geyer willow	78%	1.38	2	400	600	70%	1.88	2	400	800	200	-8%
002_02	Camp Creek	9	150	Geyer willow	78%	1.38	2	300	400	90%	0.63	2	300	200	(200)	0%
002_02	Camp Creek	10	110	Geyer willow	78%	1.38	2	200	300	80%	1.25	2	200	300	0	0%
002_02	Camp Creek	11	140	Geyer willow	78%	1.38	2	300	400	40%	3.76	2	300	1,000	600	-38%
002_02	Camp Creek	12	91	Geyer willow	78%	1.38	2	200	300	80%	1.25	2	200	300	0	0%
002_02	Camp Creek	13	170	Geyer willow	61%	2.45	3	500	1,000	20%	5.02	3	500	3,000	2,000	-41%
002_02	Camp Creek	14	260	Geyer willow	61%	2.45	3	800	2,000	70%	1.88	3	800	2,000	0	0%
002_02	Camp Creek	15	110	Geyer willow	61%	2.45	3	300	700	30%	4.39	3	300	1,000	300	-31%
002_02	Camp Creek	16	200	Geyer willow	61%	2.45	3	600	1,000	50%	3.14	3	600	2,000	1,000	-11%
002_02	Camp Creek	17	450	Geyer willow	61%	2.45	3	1,000	2,000	0%	6.27	3	1,000	6,000	4,000	-61%
002_02	Camp Creek	18	130	Geyer willow	61%	2.45	3	400	1,000	60%	2.51	3	400	1,000	0	-1%
002_02	Camp Creek	19	340	Geyer willow	50%	3.14	4	1,000	3,000	60%	2.51	4	1,000	3,000	0	0%
002_02	Camp Creek	20	190	Geyer willow	50%	3.14	4	800	3,000	10%	5.64	4	800	5,000	2,000	-40%
002_02	Camp Creek	21	130	Geyer willow	50%	3.14	4	500	2,000	30%	4.39	4	500	2,000	0	-20%
002_02	Camp Creek	22	51	Geyer willow	50%	3.14	4	200	600	0%	6.27	4	200	1,000	400	-50%
002_02	Camp Creek	23	140	Geyer willow	50%	3.14	4	600	2,000	50%	3.14	4	600	2,000	0	0%
002_02	Camp Creek	24	320	Geyer willow	50%	3.14	4	1,000	3,000	10%	5.64	4	1,000	6,000	3,000	-40%
002_02	Camp Creek	25	220	Geyer willow	50%	3.14	4	900	3,000	50%	3.14	4	900	3,000	0	0%
002_02	Camp Creek	26	170	Geyer willow	50%	3.14	4	700	2,000	60%	2.51	4	700	2,000	0	0%
002_02	Camp Creek	27	89	Geyer willow	43%	3.57	5	400	1,000	40%	3.76	5	400	2,000	1,000	-3%
002_02	Camp Creek	28	320	Geyer willow	43%	3.57	5	2,000	7,000	60%	2.51	5	2,000	5,000	(2,000)	0%
002_02	Camp Creek	29	110	Geyer willow	43%	3.57	5	600	2,000	40%	3.76	5	600	2,000	0	-3%
002_02	Camp Creek	30	310	cottonwood	87%	0.82	5	2,000	2,000	70%	1.88	5	2,000	4,000	2,000	-17%
002_02	Camp Creek	31	230	Geyer willow	43%	3.57	5	1,000	4,000	40%	3.76	5	1,000	4,000	0	-3%
002_02	Camp Creek	32	210	cottonwood	87%	0.82	5	1,000	800	60%	2.51	5	1,000	3,000	2,000	-27%
002_02	Camp Creek	33	200	cottonwood	87%	0.82	5	1,000	800	50%	3.14	5	1,000	3,000	2,000	-37%
002_02	Camp Creek	34	480	cottonwood	87%	0.82	5	2,000	2,000	60%	2.51	5	2,000	5,000	3,000	-27%
002_02	Camp Creek	35	160	Geyer willow	43%	3.57	5	800	3,000	30%	4.39	5	800	4,000	1,000	-13%
002_02	Camp Creek	36	1400	cottonwood	87%	0.82	5	7,000	6,000	60%	2.51	5	7,000	20,000	10,000	-27%
002_02	Camp Creek	37	230	sandbar willow	50%	3.14	5	1,000	3,000	20%	5.02	5	1,000	5,000	2,000	-30%
002_02	Camp Creek	38	230	sandbar willow	50%	3.14	5	1,000	3,000	30%	4.39	5	1,000	4,000	1,000	-20%
002_02	Camp Creek	39	840	sandbar willow	50%	3.14	5	4,000	10,000	20%	5.02	5	4,000	20,000	10,000	-30%
002_02	Camp Creek	40	760	sandbar willow	50%	3.14	5	4,000	10,000	30%	4.39	5	4,000	20,000	10,000	-20%
002_02	Camp Creek	41	390	sandbar willow	44%	3.51	6	2,000	7,000	50%	3.14	6	2,000	6,000	(1,000)	0%
002_02	Camp Creek	42	180	sandbar willow	39%	3.82	7	1,000	4,000	30%	4.39	7	1,000	4,000	0	-9%

Table 17 (cont.). Existing and target solar loads for the Camp Creek watershed (AU ID17040220SK002_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_02	Jumbo Canyon	1	420	alder	91%	0.56	1	400	200	80%	1.25	1	400	500	300	-11%
002_02	Jumbo Canyon	2	1100	cottonwood	98%	0.13	1	1,000	100	90%	0.63	1	1,000	600	500	-8%
002_02	Jumbo Canyon	3	230	alder	86%	0.88	2	500	400	60%	2.51	2	500	1,000	600	-26%
002_02	Jumbo Canyon	4	830	alder	86%	0.88	2	2,000	2,000	80%	1.25	2	2,000	3,000	1,000	-6%
002_02	Jumbo Canyon	5	100	alder	86%	0.88	2	200	200	60%	2.51	2	200	500	300	-26%
002_02	Jumbo Canyon	6	140	alder	86%	0.88	2	300	300	80%	1.25	2	300	400	100	-6%
002_02	Jumbo Canyon	7	86	Geyer willow	78%	1.38	2	200	300	50%	3.14	2	200	600	300	-28%
002_02	Jumbo Canyon	8	85	Geyer willow	78%	1.38	2	200	300	90%	0.63	2	200	100	(200)	0%
002_02	Eagle Creek	1	160	Geyer willow	92%	0.50	1	200	100	80%	1.25	1	200	300	200	-12%
002_02	Eagle Creek	2	770	alder	91%	0.56	1	800	500	80%	1.25	1	800	1,000	500	-11%
002_02	Eagle Creek	3	290	Geyer willow	92%	0.50	1	300	200	80%	1.25	1	300	400	200	-12%
002_02	Eagle Creek	4	220	Geyer willow	78%	1.38	2	400	600	90%	0.63	2	400	300	(300)	0%
002_02	Eagle Creek	5	200	Geyer willow	78%	1.38	2	400	600	40%	3.76	2	400	2,000	1,000	-38%
002_02	Eagle Creek	6	370	Geyer willow	78%	1.38	2	700	1,000	70%	1.88	2	700	1,000	0	-8%
002_02	Eagle Creek	7	200	Geyer willow	78%	1.38	2	400	600	30%	4.39	2	400	2,000	1,000	-48%
002_02	Eagle Creek	8	200	Geyer willow	78%	1.38	2	400	600	0%	6.27	2	400	3,000	2,000	-78%
002_02	Eagle Creek	9	250	Geyer willow	78%	1.38	2	500	700	70%	1.88	2	500	900	200	-8%
002_02	Eagle Creek	10	150	Geyer willow	78%	1.38	2	300	400	50%	3.14	2	300	900	500	-28%
002_02	Eagle Creek	11	190	Geyer willow	78%	1.38	2	400	600	80%	1.25	2	400	500	(100)	0%
002_02	Eagle Creek	12	220	Geyer willow	78%	1.38	2	400	600	20%	5.02	2	400	2,000	1,000	-58%
002_02	Eagle Creek	13	240	Geyer willow	78%	1.38	2	500	700	0%	6.27	2	500	3,000	2,000	-78%
002_02	un-named	1	820	Geyer willow	92%	0.50	1	800	400	80%	1.25	1	800	1,000	600	-12%
002_02	un-named	2	260	grass	55%	2.82	1	300	800	30%	4.39	1	300	1,000	200	-25%
002_02	un-named	3	35	grass	55%	2.82	1	40	100	0%	6.27	1	40	300	200	-55%
002_02	un-named	4	830	grass	55%	2.82	1	800	2,000	30%	4.39	1	800	4,000	2,000	-25%
002_02	un-named	5	340	grass	55%	2.82	1	300	800	0%	6.27	1	300	2,000	1,000	-55%
002_02	un-named	6	130	Geyer willow	92%	0.50	1	100	50	10%	5.64	1	100	600	600	-82%
002_02	un-named	7	64	Geyer willow	92%	0.50	1	60	30	0%	6.27	1	60	400	400	-92%
002_02	un-named	8	180	Geyer willow	92%	0.50	1	200	100	40%	3.76	1	200	800	700	-52%
002_02	un-named	9	130	Geyer willow	92%	0.50	1	100	50	10%	5.64	1	100	600	600	-82%
002_02	un-named	10	97	Geyer willow	78%	1.38	2	200	300	40%	3.76	2	200	800	500	-38%
002_02	un-named	11	300	Geyer willow	78%	1.38	2	600	800	10%	5.64	2	600	3,000	2,000	-68%
002_02	un-named	12	110	Geyer willow	78%	1.38	2	200	300	40%	3.76	2	200	800	500	-38%
002_02	un-named	13	220	Geyer willow	78%	1.38	2	400	600	0%	6.27	2	400	3,000	2,000	-78%
002_02	un-named	14	130	Geyer willow	78%	1.38	2	300	400	40%	3.76	2	300	1,000	600	-38%
002_02	un-named	15	450	Geyer willow	78%	1.38	2	900	1,000	50%	3.14	2	900	3,000	2,000	-28%
002_02	un-named	16	310	Geyer willow	78%	1.38	2	600	800	0%	6.27	2	600	4,000	3,000	-78%
002_02	un-named	17	98	Geyer willow	78%	1.38	2	200	300	10%	5.64	2	200	1,000	700	-68%
002_02	un-named	18	370	Geyer willow	78%	1.38	2	700	1,000	0%	6.27	2	700	4,000	3,000	-78%
002_02	un-named	19	570	Geyer willow	78%	1.38	2	1,000	1,000	20%	5.02	2	1,000	5,000	4,000	-58%

Table 17 (cont.). Existing and target solar loads for the Camp Creek watershed (AU ID17040220SK002_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_02	Flat Creek	1	670	Geyer willow	92%	0.50	1	700	400	90%	0.63	1	700	400	0	-2%
002_02	Flat Creek	2	85	grass	55%	2.82	1	90	300	60%	2.51	1	90	200	(100)	0%
002_02	Flat Creek	3	270	Geyer willow	92%	0.50	1	300	200	90%	0.63	1	300	200	0	-2%
002_02	Flat Creek	4	180	Geyer willow	92%	0.50	1	200	100	60%	2.51	1	200	500	400	-32%
002_02	Flat Creek	5	71	Geyer willow	92%	0.50	1	70	40	0%	6.27	1	70	400	400	-92%
002_02	Flat Creek	6	180	Geyer willow	92%	0.50	1	200	100	50%	3.14	1	200	600	500	-42%
002_02	Flat Creek	7	320	Geyer willow	92%	0.50	1	300	200	80%	1.25	1	300	400	200	-12%
002_02	Flat Creek	8	320	Geyer willow	92%	0.50	1	300	200	50%	3.14	1	300	900	700	-42%
002_02	Flat Creek	9	140	Geyer willow	92%	0.50	1	100	50	60%	2.51	1	100	300	300	-32%
002_02	Flat Creek	10	160	Geyer willow	78%	1.38	2	300	400	40%	3.76	2	300	1,000	600	-38%
002_02	Flat Creek	11	100	Geyer willow	78%	1.38	2	200	300	90%	0.63	2	200	100	(200)	0%
002_02	Flat Creek	12	610	Geyer willow	78%	1.38	2	1,000	1,000	40%	3.76	2	1,000	4,000	3,000	-38%
002_02	Flat Creek	13	300	Geyer willow	78%	1.38	2	600	800	70%	1.88	2	600	1,000	200	-8%
002_02	Flat Creek	14	160	cottonwood	97%	0.19	2	300	60	90%	0.63	2	300	200	100	-7%
002_02	Flat Creek	15	660	Geyer willow	78%	1.38	2	1,000	1,000	30%	4.39	2	1,000	4,000	3,000	-48%
002_02	Flat Creek	16	370	cottonwood	97%	0.19	2	700	100	60%	2.51	2	700	2,000	2,000	-37%
002_02	Brush Creek	1	780	Geyer willow	92%	0.50	1	800	400	80%	1.25	1	800	1,000	600	-12%
002_02	Brush Creek	2	520	Geyer willow	92%	0.50	1	500	300	90%	0.63	1	500	300	0	-2%
002_02	Brush Creek	3	570	Geyer willow	92%	0.50	1	600	300	80%	1.25	1	600	800	500	-12%
002_02	Brush Creek	4	910	Geyer willow	92%	0.50	1	900	500	90%	0.63	1	900	600	100	-2%
002_02	Brush Creek	5	450	Geyer willow	92%	0.50	1	500	300	80%	1.25	1	500	600	300	-12%
002_02	Brush Creek	6	1500	Geyer willow	78%	1.38	2	3,000	4,000	80%	1.25	2	3,000	4,000	0	0%
002_02	Brush Creek	7	1300	Geyer willow	78%	1.38	2	3,000	4,000	70%	1.88	2	3,000	6,000	2,000	-8%
002_02	Spare Creek	1	370	alder	91%	0.56	1	400	200	90%	0.63	1	400	300	100	-1%
002_02	Spare Creek	2	280	Geyer willow	92%	0.50	1	300	200	20%	5.02	1	300	2,000	2,000	-72%
002_02	Spare Creek	3	810	Geyer willow	78%	1.38	2	2,000	3,000	80%	1.25	2	2,000	3,000	0	0%
002_02	Tolmie Creek	1	720	Geyer willow	92%	0.50	1	700	400	90%	0.63	1	700	400	0	-2%
002_02	Tolmie Creek	2	190	Geyer willow	92%	0.50	1	200	100	50%	3.14	1	200	600	500	-42%
002_02	Tolmie Creek	3	1300	Geyer willow	92%	0.50	1	1,000	500	90%	0.63	1	1,000	600	100	-2%
002_02	Tolmie Creek	4	310	Geyer willow	92%	0.50	1	300	200	40%	3.76	1	300	1,000	800	-52%
002_02	Shirley Spring Cr	1	93	yellow willow	89%	0.69	1	90	60	50%	3.14	1	90	300	200	-39%
002_02	Shirley Spring Cr	2	260	yellow willow	89%	0.69	1	300	200	90%	0.63	1	300	200	0	0%
002_02	Shirley Spring Cr	3	260	yellow willow	89%	0.69	1	300	200	50%	3.14	1	300	900	700	-39%
002_02	Shirley Spring Cr	4	110	yellow willow	73%	1.69	2	200	300	60%	2.51	2	200	500	200	-13%
002_02	Shirley Spring Cr	5	160	yellow willow	73%	1.69	2	300	500	30%	4.39	2	300	1,000	500	-43%
002_02	Shirley Spring Cr	6	94	yellow willow	73%	1.69	2	200	300	0%	6.27	2	200	1,000	700	-73%
002_02	Shirley Spring Cr	7	380	yellow willow	73%	1.69	2	800	1,000	50%	3.14	2	800	3,000	2,000	-23%
002_02	spring	1	120	yellow willow	89%	0.69	1	100	70	80%	1.25	1	100	100	30	-9%
002_02	spring	2	91	yellow willow	89%	0.69	1	90	60	90%	0.63	1	90	60	0	0%
002_02	spring	3	78	grass	55%	2.82	1	80	200	50%	3.14	1	80	300	100	-5%
							Totals		140,000					260,000	110,000	

Table 18. Existing and target solar loads for Camp Creek (AU ID17040220SK002_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_03	Camp Creek	1	210	sandbar willow	39%	3.82	7	1,000	4,000	20%	5.02	7	1,000	5,000	1,000	-19%
002_03	Camp Creek	2	2100	sandbar willow	39%	3.82	7	10,000	40,000	70%	1.88	7	10,000	20,000	(20,000)	0%
002_03	Camp Creek	3	230	sandbar willow	39%	3.82	7	2,000	8,000	60%	2.51	7	2,000	5,000	(3,000)	0%
002_03	Camp Creek	4	320	sandbar willow	39%	3.82	7	2,000	8,000	30%	4.39	7	2,000	9,000	1,000	-9%
002_03	Camp Creek	5	600	sandbar willow	39%	3.82	7	4,000	20,000	50%	3.14	7	4,000	10,000	(10,000)	0%
002_03	Camp Creek	6	150	sandbar willow	39%	3.82	7	1,000	4,000	30%	4.39	7	1,000	4,000	0	-9%
002_03	Camp Creek	7	310	sandbar willow	39%	3.82	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-29%
002_03	Camp Creek	8	360	sandbar willow	39%	3.82	7	3,000	10,000	30%	4.39	7	3,000	10,000	0	-9%
002_03	Camp Creek	9	240	sandbar willow	39%	3.82	7	2,000	8,000	70%	1.88	7	2,000	4,000	(4,000)	0%
002_03	Camp Creek	10	370	sandbar willow	39%	3.82	7	3,000	10,000	50%	3.14	7	3,000	9,000	(1,000)	0%
002_03	Camp Creek	11	570	sandbar willow	39%	3.82	7	4,000	20,000	30%	4.39	7	4,000	20,000	0	-9%
002_03	Camp Creek	12	450	sandbar willow	39%	3.82	7	3,000	10,000	10%	5.64	7	3,000	20,000	10,000	-29%
002_03	Camp Creek	13	620	sandbar willow	39%	3.82	7	4,000	20,000	20%	5.02	7	4,000	20,000	0	-19%
							Totals		170,000					150,000	-24,000	

Table 19. Existing and target solar loads for Corral Creek (AU ID17040220SK015_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_03	Corral Creek	1	590	sandbar willow	44%	3.51	6	4,000	10,000	10%	5.64	6	4,000	20,000	10,000	-34%
015_03	Corral Creek	2	590	sandbar willow	44%	3.51	6	4,000	10,000	0%	6.27	6	4,000	30,000	20,000	-44%
015_03	Corral Creek	3	290	sandbar willow	44%	3.51	6	2,000	7,000	10%	5.64	6	2,000	10,000	3,000	-34%
015_03	Corral Creek	4	650	sandbar willow	44%	3.51	6	4,000	10,000	0%	6.27	6	4,000	30,000	20,000	-44%
015_03	Corral Creek	5	100	sandbar willow	70%	1.88	3	300	600	0%	6.27	3	300	2,000	1,000	-70%
015_03	Corral Creek	6	440	sandbar willow	70%	1.88	3	1,000	2,000	60%	2.51	3	1,000	3,000	1,000	-10%
015_03	Corral Creek	7	370	sandbar willow	70%	1.88	3	1,000	2,000	40%	3.76	3	1,000	4,000	2,000	-30%
015_03	Corral Creek	8	420	sandbar willow	70%	1.88	3	1,000	2,000	50%	3.14	3	1,000	3,000	1,000	-20%
015_03	Corral Creek	9	490	sandbar willow	70%	1.88	3	1,000	2,000	0%	6.27	3	1,000	6,000	4,000	-70%
015_03	Corral Creek	10	750	sandbar willow	70%	1.88	3	2,000	4,000	10%	5.64	3	2,000	10,000	6,000	-60%
015_03	Corral Creek	11	180	sandbar willow	70%	1.88	3	500	900	0%	6.27	3	500	3,000	2,000	-70%
015_03	Corral Creek	12	210	sandbar willow	70%	1.88	3	600	1,000	30%	4.39	3	600	3,000	2,000	-40%
015_03	Corral Creek	13	820	sandbar willow	70%	1.88	3	2,000	4,000	0%	6.27	3	2,000	10,000	6,000	-70%
015_03	Corral Creek	14	300	sandbar willow	70%	1.88	3	900	2,000	30%	4.39	3	900	4,000	2,000	-40%
015_03	Corral Creek	15	430	sandbar willow	70%	1.88	3	1,000	2,000	50%	3.14	3	1,000	3,000	1,000	-20%
015_03	Corral Creek	16	550	sandbar willow	44%	3.51	6	3,000	10,000	30%	4.39	6	3,000	10,000	0	-14%
015_03	Corral Creek	17	200	sandbar willow	44%	3.51	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-34%
015_03	Corral Creek	18	820	sandbar willow	44%	3.51	6	5,000	20,000	20%	5.02	6	5,000	30,000	10,000	-24%
015_03	Corral Creek	19	230	sandbar willow	39%	3.82	7	2,000	8,000	30%	4.39	7	2,000	9,000	1,000	-9%
015_03	Corral Creek	20	730	sandbar willow	39%	3.82	7	5,000	20,000	40%	3.76	7	5,000	20,000	0	0%
015_03	Corral Creek	21	460	sandbar willow	39%	3.82	7	3,000	10,000	50%	3.14	7	3,000	9,000	(1,000)	0%
015_03	Corral Creek	22	520	sandbar willow	39%	3.82	7	4,000	20,000	30%	4.39	7	4,000	20,000	0	-9%
015_03	Corral Creek	23	69	sandbar willow	39%	3.82	7	500	2,000	0%	6.27	7	500	3,000	1,000	-39%
015_03	Corral Creek	24	310	sandbar willow	39%	3.82	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-29%
015_03	Corral Creek	25	450	sandbar willow	39%	3.82	7	3,000	10,000	20%	5.02	7	3,000	20,000	10,000	-19%
015_03	Corral Creek	26	220	sandbar willow	39%	3.82	7	2,000	8,000	30%	4.39	7	2,000	9,000	1,000	-9%
015_03	Corral Creek	27	150	sandbar willow	39%	3.82	7	1,000	4,000	10%	5.64	7	1,000	6,000	2,000	-29%
015_03	Corral Creek	28	160	sandbar willow	39%	3.82	7	1,000	4,000	0%	6.27	7	1,000	6,000	2,000	-39%
015_03	Corral Creek	29	360	sandbar willow	39%	3.82	7	3,000	10,000	10%	5.64	7	3,000	20,000	10,000	-29%
015_03	Corral Creek	30	240	sandbar willow	39%	3.82	7	2,000	8,000	20%	5.02	7	2,000	10,000	2,000	-19%
015_03	Corral Creek	31	670	sandbar willow	39%	3.82	7	5,000	20,000	10%	5.64	7	5,000	30,000	10,000	-29%
015_03	Corral Creek	32	290	sandbar willow	39%	3.82	7	2,000	8,000	20%	5.02	7	2,000	10,000	2,000	-19%
015_03	Corral Creek	33	2800	sandbar willow	39%	3.82	7	20,000	80,000	10%	5.64	7	20,000	100,000	20,000	-29%
							Totals		310,000					470,000	160,000	

Table 20. Existing and target solar loads for Soldier Creek (AU ID17040220SK011_03), formerly 011_02.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
011_03	Soldier Creek	1	230	sandbar willow	35%	4.08	8	2,000	8,000	50%	3.14	8	2,000	6,000	(2,000)	0%
011_03	Soldier Creek	2	630	sandbar willow	35%	4.08	8	5,000	20,000	30%	4.39	8	5,000	20,000	0	-5%
011_03	Soldier Creek	3	660	sandbar willow	35%	4.08	8	5,000	20,000	50%	3.14	8	5,000	20,000	0	0%
011_03	Soldier Creek	4	300	sandbar willow	35%	4.08	8	2,000	8,000	30%	4.39	8	2,000	9,000	1,000	-5%
011_03	Soldier Creek	5	140	sandbar willow	35%	4.08	8	1,000	4,000	40%	3.76	8	1,000	4,000	0	0%
011_03	Soldier Creek	6	740	sandbar willow	35%	4.08	8	6,000	20,000	20%	5.02	8	6,000	30,000	10,000	-15%
011_03	Soldier Creek	8	870	sandbar willow	35%	4.08	8	7,000	30,000	40%	3.76	8	7,000	30,000	0	0%
011_03	Soldier Creek	9	250	sandbar willow	35%	4.08	8	2,000	8,000	30%	4.39	8	2,000	9,000	1,000	-5%
011_03	Soldier Creek	10	460	sandbar willow	35%	4.08	8	4,000	20,000	10%	5.64	8	4,000	20,000	0	-25%
011_03	Soldier Creek	11	76	sandbar willow	35%	4.08	8	600	2,000	0%	6.27	8	600	4,000	2,000	-35%
011_03	Soldier Creek	12	120	sandbar willow	35%	4.08	8	1,000	4,000	10%	5.64	8	1,000	6,000	2,000	-25%
011_03	Soldier Creek	13	220	sandbar willow	35%	4.08	8	2,000	8,000	0%	6.27	8	2,000	10,000	2,000	-35%
011_03	Soldier Creek	14	500	sandbar willow	35%	4.08	8	4,000	20,000	10%	5.64	8	4,000	20,000	0	-25%
011_03	Soldier Creek	15	500	sandbar willow	35%	4.08	8	4,000	20,000	30%	4.39	8	4,000	20,000	0	-5%
011_03	Soldier Creek	16	490	sandbar willow	35%	4.08	8	4,000	20,000	20%	5.02	8	4,000	20,000	0	-15%
011_03	Soldier Creek	17	1500	sandbar willow	35%	4.08	9	10,000	40,000	50%	3.14	9	10,000	30,000	(10,000)	0%
011_03	Soldier Creek	18	320	sandbar willow	32%	4.26	9	3,000	10,000	30%	4.39	9	3,000	10,000	0	-2%
011_03	Soldier Creek	19	130	sandbar willow	32%	4.26	9	1,000	4,000	10%	5.64	9	1,000	6,000	2,000	-22%
011_03	Soldier Creek	20	210	sandbar willow	32%	4.26	9	2,000	9,000	0%	6.27	9	2,000	10,000	1,000	-32%
011_03	Soldier Creek	21	110	sandbar willow	32%	4.26	9	1,000	4,000	10%	5.64	9	1,000	6,000	2,000	-22%
011_03	Soldier Creek	22	240	sandbar willow	32%	4.26	9	2,000	9,000	0%	6.27	9	2,000	10,000	1,000	-32%
011_03	Soldier Creek	23	220	sandbar willow	32%	4.26	9	2,000	9,000	20%	5.02	9	2,000	10,000	1,000	-12%
011_03	Soldier Creek	24	200	sandbar willow	32%	4.26	9	2,000	9,000	30%	4.39	9	2,000	9,000	0	-2%
011_03	Soldier Creek	25	1100	sandbar willow	32%	4.26	9	10,000	40,000	40%	3.76	9	10,000	40,000	0	0%
011_03	Soldier Creek	26	260	sandbar willow	32%	4.26	9	2,000	9,000	30%	4.39	9	2,000	9,000	0	-2%
011_03	Soldier Creek	27	120	sandbar willow	32%	4.26	9	1,000	4,000	10%	5.64	9	1,000	6,000	2,000	-22%
011_03	Soldier Creek	28	170	sandbar willow	32%	4.26	9	2,000	9,000	20%	5.02	9	2,000	10,000	1,000	-12%
011_03	Soldier Creek	29	64	sandbar willow	32%	4.26	9	600	3,000	0%	6.27	9	600	4,000	1,000	-32%
011_03	Soldier Creek	30	180	sandbar willow	32%	4.26	9	2,000	9,000	20%	5.02	9	2,000	10,000	1,000	-12%
011_03	Soldier Creek	31	1700	sandbar willow	32%	4.26	9	20,000	90,000	10%	5.64	9	20,000	100,000	10,000	-22%
011_03	Soldier Creek	32	93	sandbar willow	32%	4.26	9	800	3,000	30%	4.39	9	800	4,000	1,000	-2%
011_03	Soldier Creek	33	520	sandbar willow	29%	4.45	10	5,200	23,000	0%	6.27	10	5,200	33,000	10,000	-29%
011_03	Soldier Creek	34	710	sandbar willow	29%	4.45	10	7,100	32,000	20%	5.02	10	7,100	36,000	4,000	-9%
011_03	Soldier Creek	35	190	sandbar willow	29%	4.45	10	1,900	8,500	10%	5.64	10	1,900	11,000	2,500	-19%
011_03	Soldier Creek	36	1300	sandbar willow	50%	3.14	5	7,000	20,000	10%	5.64	5	7,000	40,000	20,000	-40%
011_03	Soldier Creek	37	150	sandbar willow	50%	3.14	5	800	3,000	40%	3.76	5	800	3,000	0	-10%
011_03	Soldier Creek	38	380	sandbar willow	50%	3.14	5	2,000	6,000	30%	4.39	5	2,000	9,000	3,000	-20%
011_03	Soldier Creek	39	460	sandbar willow	50%	3.14	5	2,000	6,000	20%	5.02	5	2,000	10,000	4,000	-30%
011_03	Soldier Creek	40	260	sandbar willow	50%	3.14	5	1,000	3,000	0%	6.27	5	1,000	6,000	3,000	-50%
011_03	Soldier Creek	41	670	sandbar willow	29%	4.45	10	6,700	30,000	0%	6.27	10	6,700	42,000	12,000	-29%
011_03	Soldier Creek	43	400	sandbar willow	50%	3.14	5	2,000	6,000	0%	6.27	5	2,000	10,000	4,000	-50%
011_03	Soldier Creek	44	240	sandbar willow	50%	3.14	5	1,000	3,000	10%	5.64	5	1,000	6,000	3,000	-40%
011_03	Soldier Creek	46	1800	sandbar willow	50%	3.14	5	9,000	30,000	0%	6.27	5	9,000	60,000	30,000	-50%
							Totals		640,000					770,000	120,000	

Table 21. Existing and target solar loads for Wild Horse Creek (AU ID17040220SK021_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
021_03	Wild Horse Creek	1	120	sandbar willow	58%	2.63	4	500	1,000	0%	6.27	4	500	3,000	2,000	-58%
021_03	Wild Horse Creek	2	110	sandbar willow	58%	2.63	4	400	1,000	40%	3.76	4	400	2,000	1,000	-18%
021_03	Wild Horse Creek	3	2800	sandbar willow	58%	2.63	4	10,000	30,000	0%	6.27	4	10,000	60,000	30,000	-58%
021_03	Wild Horse Creek	4	590	sandbar willow	58%	2.63	4	2,000	5,000	20%	5.02	4	2,000	10,000	5,000	-38%
021_03	Wild Horse Creek	5	71	sandbar willow	58%	2.63	4	300	800	0%	6.27	4	300	2,000	1,000	-58%
021_03	Wild Horse Creek	6	150	sandbar willow	58%	2.63	4	600	2,000	20%	5.02	4	600	3,000	1,000	-38%
021_03	Wild Horse Creek	7	250	sandbar willow	58%	2.63	4	1,000	3,000	10%	5.64	4	1,000	6,000	3,000	-48%
021_03	Wild Horse Creek	8	350	sandbar willow	58%	2.63	4	1,000	3,000	0%	6.27	4	1,000	6,000	3,000	-58%
021_03	Wild Horse Creek	9	230	sandbar willow	58%	2.63	4	900	2,000	10%	5.64	4	900	5,000	3,000	-48%
021_03	Wild Horse Creek	10	170	sandbar willow	58%	2.63	4	700	2,000	0%	6.27	4	700	4,000	2,000	-58%
021_03	Wild Horse Creek	11	670	sandbar willow	58%	2.63	4	3,000	8,000	10%	5.64	4	3,000	20,000	10,000	-48%
021_03	Wild Horse Creek	12	110	sandbar willow	50%	3.14	5	600	2,000	0%	6.27	5	600	4,000	2,000	-50%
021_03	Wild Horse Creek	13	630	sandbar willow	50%	3.14	5	3,000	9,000	20%	5.02	5	3,000	20,000	10,000	-30%
021_03	Wild Horse Creek	14	450	sandbar willow	50%	3.14	5	2,000	6,000	0%	6.27	5	2,000	10,000	4,000	-50%
021_03	Wild Horse Creek	15	2300	sandbar willow	50%	3.14	5	10,000	30,000	10%	5.64	5	10,000	60,000	30,000	-40%
021_03	Wild Horse Creek	16	1500	sandbar willow	50%	3.14	5	8,000	30,000	0%	6.27	5	8,000	50,000	20,000	-50%
							Totals		130,000					270,000	130,000	

Table 22. Existing and target solar loads for Willow Creek (AU ID17040220SK003_04).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_04	Willow Creek	1	330	Geyer willow	37%	3.95	6	2,000	8,000	10%	5.64	6	2,000	10,000	2,000	-27%
003_04	Willow Creek	2	490	Geyer willow	37%	3.95	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-17%
003_04	Willow Creek	3	300	Geyer willow	37%	3.95	6	2,000	8,000	10%	5.64	6	2,000	10,000	2,000	-27%
003_04	Willow Creek	4	360	Geyer willow	37%	3.95	6	2,000	8,000	30%	4.39	6	2,000	9,000	1,000	-7%
003_04	Willow Creek	5	450	Geyer willow	37%	3.95	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-17%
003_04	Willow Creek	6	130	Geyer willow	37%	3.95	6	800	3,000	0%	6.27	6	800	5,000	2,000	-37%
003_04	Willow Creek	7	470	Geyer willow	37%	3.95	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-17%
003_04	Willow Creek	8	68	Geyer willow	37%	3.95	6	400	2,000	50%	3.14	6	400	1,000	(1,000)	0%
003_04	Willow Creek	9	590	Geyer willow	37%	3.95	6	4,000	20,000	20%	5.02	6	4,000	20,000	0	-17%
003_04	Willow Creek	10	430	Geyer willow	37%	3.95	6	3,000	10,000	40%	3.76	6	3,000	10,000	0	0%
003_04	Willow Creek	11	290	Geyer willow	37%	3.95	6	2,000	8,000	30%	4.39	6	2,000	9,000	1,000	-7%
003_04	Willow Creek	12	240	Geyer willow	37%	3.95	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-27%
003_04	Willow Creek	13	320	Geyer willow	37%	3.95	6	2,000	8,000	20%	5.02	6	2,000	10,000	2,000	-17%
003_04	Willow Creek	14	440	sandbar willow	44%	3.51	6	3,000	10,000	30%	4.39	6	3,000	10,000	0	-14%
003_04	Willow Creek	15	200	sandbar willow	44%	3.51	6	1,000	4,000	40%	3.76	6	1,000	4,000	0	-4%
003_04	Willow Creek	16	700	sandbar willow	44%	3.51	6	4,000	10,000	30%	4.39	6	4,000	20,000	10,000	-14%
003_04	Willow Creek	17	130	sandbar willow	44%	3.51	6	800	3,000	40%	3.76	6	800	3,000	0	-4%
003_04	Willow Creek	18	580	sandbar willow	44%	3.51	6	3,000	10,000	10%	5.64	6	3,000	20,000	10,000	-34%
003_04	Willow Creek	19	280	sandbar willow	44%	3.51	6	2,000	7,000	20%	5.02	6	2,000	10,000	3,000	-24%
003_04	Willow Creek	20	1100	sandbar willow	44%	3.51	6	7,000	20,000	30%	4.39	6	7,000	30,000	10,000	-14%
003_04	Willow Creek	21	740	sandbar willow	44%	3.51	6	4,000	10,000	20%	5.02	6	4,000	20,000	10,000	-24%
003_04	Willow Creek	22	300	sandbar willow	44%	3.51	6	2,000	7,000	30%	4.39	6	2,000	9,000	2,000	-14%
003_04	Willow Creek	23	120	sandbar willow	44%	3.51	6	700	2,000	70%	1.88	6	700	1,000	(1,000)	0%
003_04	Willow Creek	24	170	sandbar willow	44%	3.51	6	1,000	4,000	20%	5.02	6	1,000	5,000	1,000	-24%
003_04	Willow Creek	25	800	sandbar willow	44%	3.51	6	5,000	20,000	40%	3.76	6	5,000	20,000	0	-4%
003_04	Willow Creek	26	380	sandbar willow	44%	3.51	6	2,000	7,000	50%	3.14	6	2,000	6,000	(1,000)	0%
003_04	Willow Creek	27	170	sandbar willow	44%	3.51	6	1,000	4,000	30%	4.39	6	1,000	4,000	0	-14%
003_04	Willow Creek	28	150	sandbar willow	44%	3.51	6	900	3,000	10%	5.64	6	900	5,000	2,000	-34%
003_04	Willow Creek	29	230	sandbar willow	44%	3.51	6	1,000	4,000	30%	4.39	6	1,000	4,000	0	-14%
003_04	Willow Creek	30	66	sandbar willow	44%	3.51	6	400	1,000	0%	6.27	6	400	3,000	2,000	-44%
003_04	Willow Creek	31	380	sandbar willow	44%	3.51	6	2,000	7,000	40%	3.76	6	2,000	8,000	1,000	-4%
003_04	Willow Creek	32	400	sandbar willow	44%	3.51	6	2,000	7,000	20%	5.02	6	2,000	10,000	3,000	-24%
003_04	Willow Creek	33	190	sandbar willow	44%	3.51	6	1,000	4,000	30%	4.39	6	1,000	4,000	0	-14%
003_04	Willow Creek	34	63	sandbar willow	44%	3.51	6	400	1,000	0%	6.27	6	400	3,000	2,000	-44%
003_04	Willow Creek	35	730	sandbar willow	44%	3.51	6	4,000	10,000	20%	5.02	6	4,000	20,000	10,000	-24%
003_04	Willow Creek	36	70	sandbar willow	44%	3.51	6	400	1,000	40%	3.76	6	400	2,000	1,000	-4%
003_04	Willow Creek	37	290	sandbar willow	44%	3.51	6	2,000	7,000	20%	5.02	6	2,000	10,000	3,000	-24%
003_04	Willow Creek	38	82	sandbar willow	44%	3.51	6	500	2,000	10%	5.64	6	500	3,000	1,000	-34%
003_04	Willow Creek	39	210	sandbar willow	44%	3.51	6	1,000	4,000	30%	4.39	6	1,000	4,000	0	-14%
003_04	Willow Creek	40	170	sandbar willow	44%	3.51	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-34%
003_04	Willow Creek	41	200	sandbar willow	44%	3.51	6	1,000	4,000	20%	5.02	6	1,000	5,000	1,000	-24%
003_04	Willow Creek	42	370	sandbar willow	44%	3.51	6	2,000	7,000	30%	4.39	6	2,000	9,000	2,000	-14%
003_04	Willow Creek	43	580	sandbar willow	44%	3.51	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-24%
							Totals		300,000					430,000	130,000	

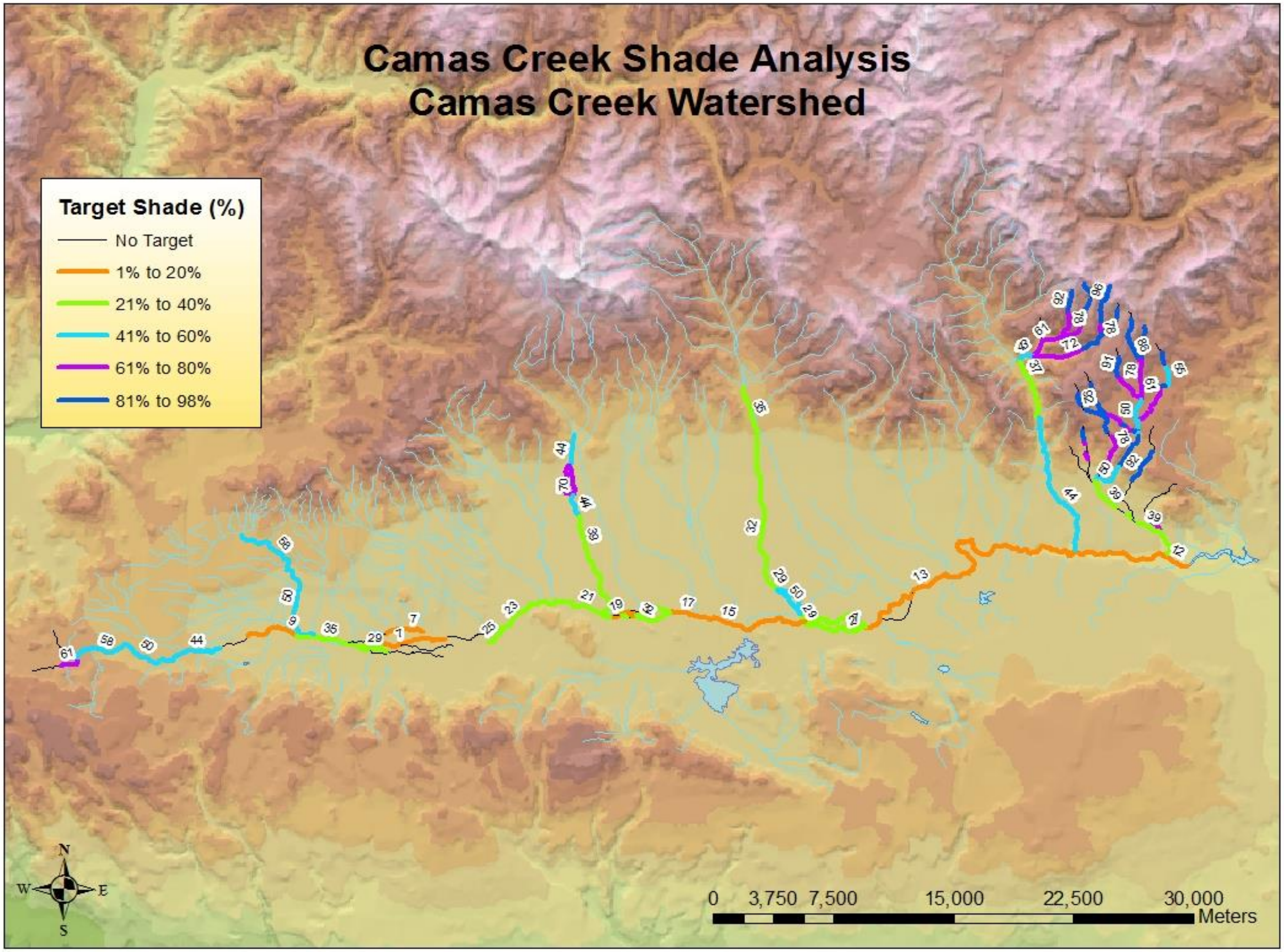

Figure 4. Target shade for the Camas Creek subbasin.

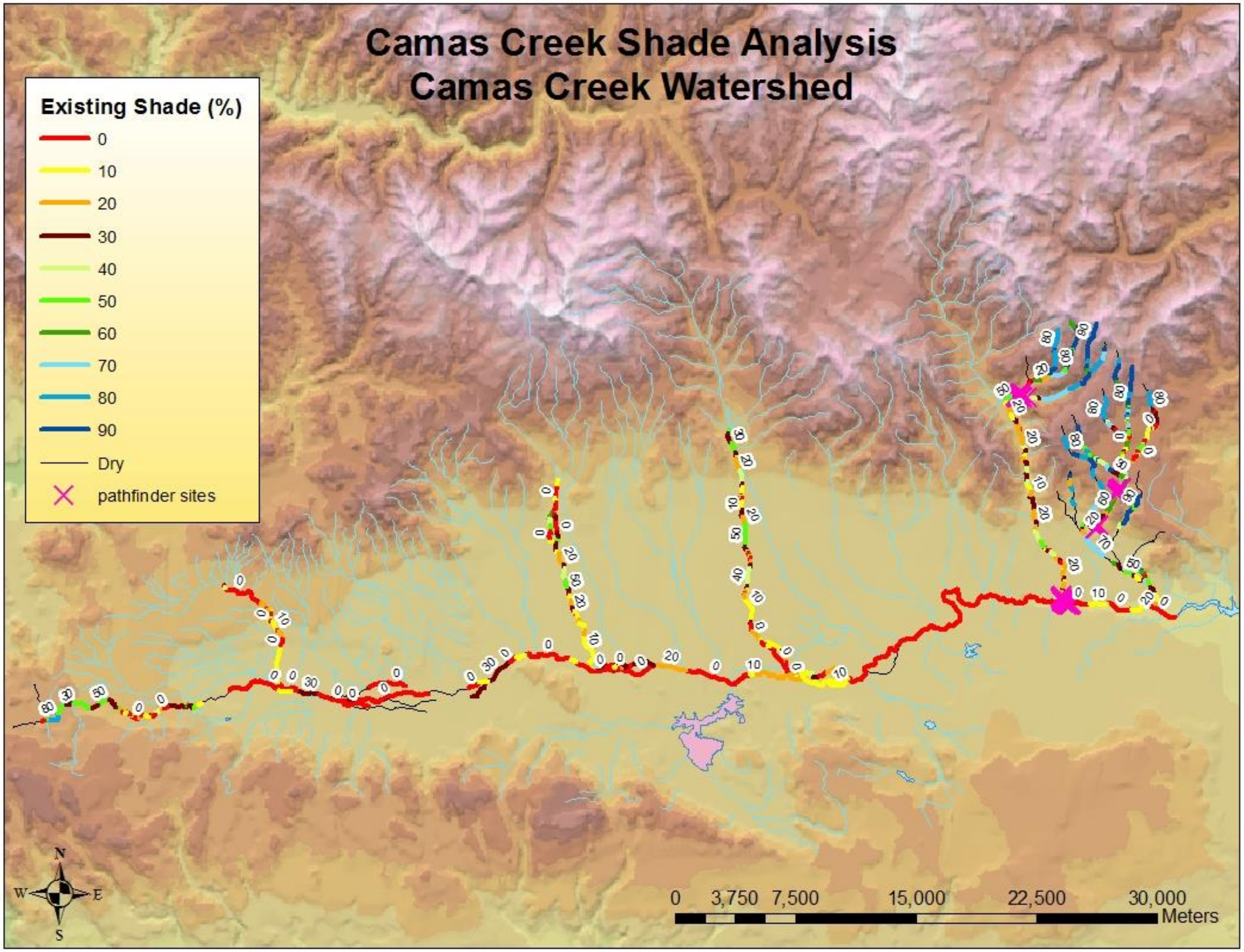

Figure 5. Existing shade estimated for the Camas Creek subbasin by aerial photo interpretation.

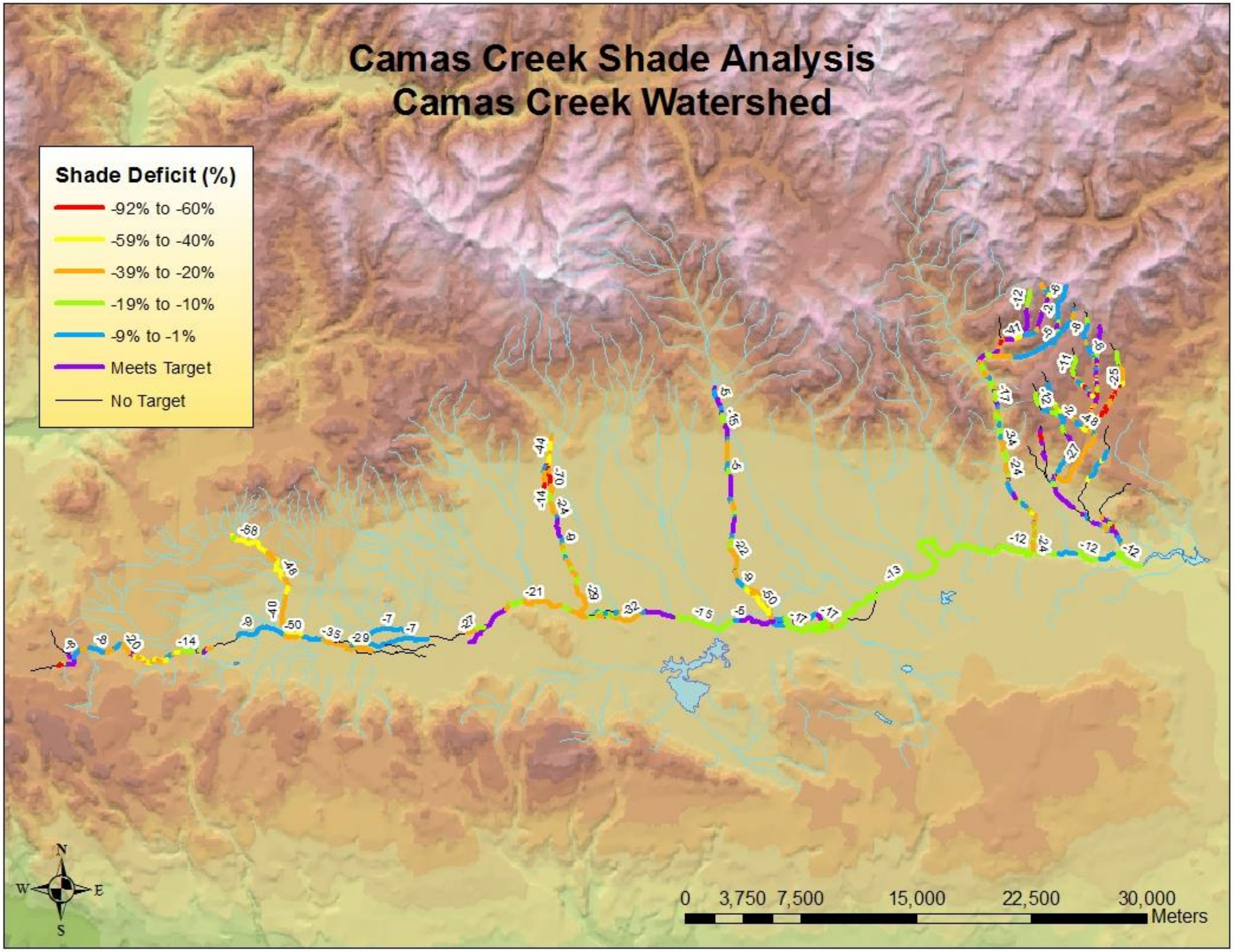

Figure 6. Shade deficit (difference between existing and target) for the Camas Creek subbasin.

5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment specific and dependent on the target load for a given segment. Table 8–Table 22 show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent on background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 23 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. Table 23 lists the AUs in order of their excess loads, from highest to lowest. Therefore, large AUs tend to be listed first and small AUs last.

Although this TMDL analysis focuses on total solar loads, it is important to note that differences between existing and target shade, as depicted in the shade deficit figures (Figure 6 and Figures C-3, C-6, C-9, C-12, and C-15), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is listed in Table 23 and provides a general level of comparison among streams.

Table 23. Total solar loads and average lack of shade for all waters.

Water Body/ Assessment Unit	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (% Reduction) (kWh/day)	Average Lack of Shade (%)
Camas Creek (ID17040220SK007_05)	2,600,000	2,300,000	330,000 (13%)	-12
Camas Creek (ID17040220SK001_05)	2,800,000	2,500,000	300,000 (11%)	-9
Camas Creek (ID17040220SK013_05)	1,700,000	1,500,000	230,000 (14%)	-12
Camas Creek (ID17040220SK018_03)	480,000	300,000	180,000 (38%)	-27
Corral Creek (ID17040220SK015_03)	470,000	310,000	160,000 (34%)	-31
Camas Creek (ID17040220SK018_04)	800,000	670,000	130,000 (16%)	-19
Wild Horse Creek (ID17040220SK021_03)	270,000	130,000	130,000 (48%)	-47
Willow Creek (ID17040220SK003_04)	430,000	300,000	130,000 (30%)	-18
Soldier Creek (ID17040220SK011_03)	770,000	640,000	120,000 (16%)	-19
Camp Creek (ID17040220SK002_02)	260,000	140,000	110,000 (42%)	-25
Camas Creek (ID17040220SK018_05)	770,000	670,000	97,000 (13%)	-13
Beaver Creek (ID17040220SK004_02)	79,000	56,000	23,000 (29%)	-17
Beaver Creek (ID17040220SK004_03)	19,000	17,000	2,000 (11%)	-7
Camas Creek (ID17040220SK018_02)	12,000	11,000	1,000 (8%)	-18
Camp Creek (ID17040220SK002_03)	150,000	170,000	0	-10

Note: Load data are rounded to two significant figures, which may present rounding errors.

In general, the 5th-order reaches of Camas Creek have the largest excess loads because they are the largest streams. However, the relative amount of excess load (percent reduction) is reasonably low (11–14%). Those streams with high excess loads relative to their existing loads (high percent reductions) include the 3rd-order reaches of Camas Creek, Corral Creek, and Wild Horse Creek and the 2nd-order AU of Camp Creek (34–48% reduction). The 3rd-order reach of Camp Creek had no excess load, and portions of Beaver Creek and Camas Creek (headwaters) had low excess loads.

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% shade class and target shade a unique integer between 0 and 100%, there is usually a difference between the two. For example, say a particular stream segment has a target shade of 86% based on its vegetation type and natural bank-full width. If existing shade on that segment were at target level, it would be recorded as 80% in the load analysis because it falls into the 80% existing shade class. This automatic difference of 6% could be attributed to the margin of safety.

For this addendum, the analysis of existing shade was enhanced by newer and better aerial imagery; 2013 National Agricultural Imagery Program imagery has a 0.5-m resolution and provides some of the clearest images we have seen to date. In addition to new imagery, we used target shade curves specifically developed from Idaho plant community data (Shumar and De Varona 2009). The original PNV TMDL for the Camas Creek subbasin completed in 2005 had to borrow target shade curves from surrounding states (Oregon, Washington, California) or other watersheds in Idaho and was not specific enough to the vegetation actually growing in the Camas Creek subbasin.

The original 2005 temperature TMDL compared to the present addendum analysis showed similar results for most streams (Table 24). Only Willow Creek and Beaver Creek show substantially different results. The present analysis shows Willow Creek in worse condition and Beaver Creek in better condition as compared to the original TMDL. The percent reduction needed in Willow Creek has increased from 2.7% to 30%. The percent reduction needed in Beaver Creek decreased from 60.4% to 26%. The remaining streams are similar with respect to necessary percent reductions. We have added AUs together for named streams for the 2014 results because we assume that they were added together when loads were reported in the 2005 TMDL. For example, the 2014 Camas Creek loads in Table 24 include all 2nd-, 3rd-, 4th-, and 5th-order AUs of Camas Creek. Similarly, Beaver Creek and Camp Creek 2014 loads include both 2nd- and 3rd-order segments added together. We assume this is true for 2005 loads as well; however, caution should be used when comparing loads directly between years as they may not represent the exact same stream lengths.

Table 24. Comparison analysis (2005 versus 2014) of total solar loads for all waters.

Stream Name	2005 Loads (kWh/day)			Necessary Reduction	2014 Loads (kWh/day)			Necessary Reduction
	Existing	Target	Excess		Existing	Target	Excess	
Soldier Creek	866,897	702,970	163,927	18.9%	770,000	640,000	120,000	16%
Willow Creek	535,073	520,836	14,237	2.7%	430,000	300,000	130,000	30%
Beaver Creek (including Little Beaver)	107,426	42,557	64,869	60.4%	98,000	73,000	25,000	26%
Camp Creek	320,220	256,830	63,390	19.8%	410,000	310,000	90,000	22%
Corral Creek	322,975	201,544	121,431	37.6%	470,000	310,000	160,000	34%
Wild Horse Creek	283,983	169,873	114,110	40.2%	270,000	130,000	130,000	48%
Camas Creek (all AUs)	4,969,018	4,506,298	462,720	9.3%	8,402,000	7,201,000	1,261,000	15%

For the future, it is advisable to refer to loads in Table 23 and all new load calculations found in Table 8–Table 22 and associated figures in this document. Load results in the 2005 temperature TMDL should be considered inaccurate and out-of-date.

5.4.1 Water Diversion

Stream temperature may be affected by diversions of water for water rights purposes. Diversion of flow reduces the amount of water exposed to a given level of solar radiation in the stream channel, which can result in increased water temperature in that channel. Loss of flow in the channel also affects the ability of the near-stream environment to support shade-producing vegetation, resulting in an increase in solar load to the channel.

Although these water temperature effects may occur, nothing in this TMDL supersedes any water appropriation in the affected watershed. Section 101(g), the Wallop Amendment, was added to the Clean Water Act as part of the 1977 amendments to address water rights. It reads as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Additionally, Idaho water quality standards indicate the following:

> The adoption of water quality standards and the enforcement of such standards are not intended to…interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure… (IDAPA 58.01.02.050.01)

In this TMDL, we have not quantified what impact, if any, diversions are having on stream temperature. Water diversions are allowed for in state statute, and it is possible for a water body to be 100% allocated. Diversions notwithstanding, reaching shade targets as discussed in the TMDL will protect what water remains in the channel and allow the stream to meet water quality standards for temperature. This TMDL will lead to cooler water by achieving shade that would be expected under natural conditions and water temperatures resulting from that shade. DEQ encourages local landowners and holders of water rights to voluntarily do whatever they can to help instream flow for the purpose of keeping channel water cooler for aquatic life.

The data included below was extracted from the Idaho Department of Water Resources, water rights, recommendations and permits databases. The points of diversion for these rights were geographically selected using the hydrologic unit 17040220 for Camas Creek. These data were joined with the water rights database. The data includes surface water rights only.

Data Summary:

- Water Rights: 1,170 individual water rights
- Recommendations: 152
- Permits: 9
- Face-value sum of the total authorized diversion rates for the rights: 421.04 cfs

- Priority dates range from 1/1/1871 through 2/6/2006 for water rights and recommendations.

Combined use limits stated in the approval conditions for the water rights may limit the total authorized diversion rates to something less than stated. For example two water rights, each authorizing a diversion rate of 3.2 cfs, may be limited to a combined total of 3.2 cfs. Water rights with the same Combined Limits ID are limited, when used together, to the combined limit amounts.

If you have questions about the data contact Idaho Department of Water Resources, Sandy Thiel at (208) 287-4881 or sandra.thiel@idwr.idaho.gov

5.4.2 Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the load analysis. Although the load analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.4.3 Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the 6-month period from April through September. This time period is when the combination of increasing air and water temperatures coincide with increasing solar inputs and vegetative shade. The critical time periods are April through June when spring salmonid spawning occurs, July and August when maximum temperatures may exceed cold water aquatic life criteria, and September when fall salmonid spawning is most likely to be affected by higher temperatures. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

5.4.4 Reasonable Assurance

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

Under §319 of the Clean Water Act, each state is required to develop and submit a nonpoint source management plan. Idaho’s most recent *Nonpoint Source Management Plan* (DEQ 2015) was submitted to and approved by EPA in March 2015. Among other things, the plan identifies programs to achieve implementation of nonpoint source best management practices (BMPs), includes a schedule for program milestones, outlines key agencies and agency roles, is certified by the state attorney general to ensure that adequate authorities exist to implement the plan, and identifies available funding sources.

Idaho's nonpoint source management program describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources. One of the prominent programs described in the plan is the provision for public involvement, such as the formation of basin advisory groups and watershed advisory groups (WAGs). The Little Wood River WAG is the designated WAG for the Camas Creek subbasin.

The Idaho water quality standards refer to existing authorities to control nonpoint pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 25.

Table 25. State of Idaho's regulatory authority for nonpoint pollution sources.

Authority	Water Quality Standards Citation	Responsible Agency
Rules Pertaining to the Idaho Forest Practices Act (IDAPA 20.02.01)	58.01.02.350.03(a)	Idaho Department of Lands
Solid Waste Management Rules and Standards (IDAPA 58.01.06)	58.01.02.350.03(b)	Idaho Department of Environmental Quality
Individual/Subsurface Sewage Disposal Rules (IDAPA 58.01.03)	58.01.02.350.03(c)	Idaho Department of Environmental Quality
Stream Channel Alteration Rules (IDAPA 37.03.07)	58.01.02.350.03(d)	Idaho Department of Water Resources
Rathdrum Prairie Sewage Disposal Regulations (Panhandle District Health Department)	58.01.02.350.03(e)	Idaho Department of Environmental Quality/Panhandle District Health Department
Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities (IDAPA 20.03.02)	58.01.02.350.03(f)	Idaho Department of Lands
Dredge and Placer Mining Operations in Idaho (IDAPA 20.03.01)	58.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste (IDAPA 02.04.14)	58.01.02.350.03(h)	Idaho State Department of Agriculture

The State of Idaho uses a voluntary approach to address agricultural nonpoint sources. However, regulatory authority can be found in the water quality standards (IDAPA 58.01.02.350.01–03). IDAPA 58.01.02.055.07 refers to the *Idaho Agricultural Pollution Abatement Plan* (Ag Plan) (ISWCC 2015), which provides direction to the agricultural community regarding approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups (soil conservation districts) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, the Ag Plan assigns the local soil conservation districts to assist the landowner/operator with developing and implementing BMPs to abate nonpoint source pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations determined to be an imminent and substantial danger to public health or the environment (IDAPA 58.01.02.350.02.a).

The Idaho water quality standards specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary, the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the DEQ director's authority provided in Idaho Code §39-108 (IDAPA 58.01.02.350). The water quality standards list designated agencies responsible for reviewing and revising nonpoint source BMPs (see section 5.6.3).

5.4.5 Construction Stormwater and TMDL Wasteload Allocation

Stormwater runoff is water from rain or snowmelt that does not immediately infiltrate into the ground and flows over or through natural or man-made storage or conveyance systems. When undeveloped areas are converted to land uses with impervious surfaces—such as buildings, parking lots, and roads—the natural hydrology of the land is altered and can result in increased surface runoff rates, volumes, and pollutant loads. Certain types of stormwater runoff are considered point source discharges for Clean Water Act purposes, including stormwater that is associated with municipal separate storm sewer systems (MS4s), industrial stormwater covered under the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit. For more information about these permits and managing stormwater, see Appendix D.

5.4.6 Reserve for Growth

A growth reserve is not included in this TMDL. The load capacities have been allocated to the existing nonpoint sources in the watershed. No new sources are expected, but any new source will be required to meet the requirements of this TMDL.

5.5 Wasteload Allocation

There is one (City of Fairfield) known National Pollutant Discharge Elimination System (NPDES) permitted point sources in the affected watersheds, and wasteload allocations presented in the 2005 TMDL remain in effect. Should a point source be proposed that would have thermal consequences on these waters, background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09; IDAPA 58.01.02.401.01) should be involved (see Appendix B).

The 2005 approved TMDL (DEQ 2005a) for the Camas Creek subbasin listed the wasteload allocation for the City of Fairfield NPDES discharge as follows (and Table 26):

> *"The wasteload allocation for Soldier Creek incorporates construction storm water wasteload allocations, as well as wasteload allocations for the City of Fairfield. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. The wasteload allocation for construction storm water is 1.7 t/yr. The wasteload allocation for the City of Fairfield is 7.5 t/yr. The intent of this sediment TMDL is not to make the City of Fairfield's discharge permit any more restrictive than it already is. The combined sediment wasteload allocation for Soldier Creek is 9.2 t/yr.*

Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed. However, there is a point source facility that does discharge to the creek.

This temperature TMDL is based on meeting potential natural riparian vegetation conditions in the watershed. Shade targets were developed with the idea that once shade levels are met, streams will achieve temperatures consistent with those achievable under natural conditions. Once natural conditions are known, point source discharges must not cumulatively increase receiving water temperature more than 0.3ºC above the natural stream temperature as stated in Idaho water quality standards (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03.v).

Prior to determining the natural temperature condition in a stream, point source discharges should not contribute water that will elevate the temperature of the receiving water above a 0.3 degree increase above average salmonid spawning temperatures (9 degrees Celsius), during the period of elevated temperatures (March 15 through July 15). The temperature of the effluent the point source will be capable of discharging will vary according to effluent flows and creek flows (Table 73). Additionally, point source dischargers should collect monitoring data on the temperature of their discharge and their receiving stream immediately above and below the discharge point. These data can be used in the future to ascertain applicability of the above referenced natural background provisions."

Table 26. "Table 73" partially reprinted from the original 2005 TMDL for Camas Creek Subbasin.

Soldier Creek Flow (cfs)	Fairfield Effluent Discharge (cfs)				
	0.05	**0.1**	**0.15**	**0.2**	**0.225**
5	16.8	13.1	11.8	11.2	11.0
10	24.3	16.8	14.3	13.1	12.6
20		24.3	19.3	16.8	16.0
30			24.3	20.6	19.3
40				24.3	22.6
50					26.0
60					
70					

Note: Effluent temperatures above 26°C are unlikely to occur and have been removed from the table. The calculation used to determine the effluent temperatures is {[(effluent flow + (0.25 x creek flow)) x (9 + 0.3)] – [(0.25 x creek flow) x 9]} / effluent flow.

The formula in the footnote of Table 73 (DEQ 2005a) was at one time thought to be incorrect at the time of submission for EPA approval. The approval letter from EPA references this correction, however, did not include it. The reference appears to have been lost and is not reproducible. Currently, we are not aware any problems with the formula. The formula as stated in the Table 73 (DEQ 2005a) footnote reproduces the table values shown.

5.6 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Table 8–Table 22). These tables need to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired load reductions.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. Reasonable assurance (section 5.4.4) for the TMDL to meet water quality standards is based on the implementation strategy. There may be a variety of reasons that individual stream segments do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land-use activities (e.g., logging, grazing, and mining). It is important that existing shade for each stream segment be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. The information in this TMDL may need further adjustment to reflect new information and conditions in the future.

5.6.1 Time Frame

Implementation of this TMDL relies on riparian area management practices that will provide a mature canopy cover to shade the stream and prevent excess solar loading. Because implementation is dependent on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount of time for achieving water quality standards. Shade targets will not be achieved all at once. Given their smaller bank-full widths, targets for smaller streams may be reached sooner than those for larger streams.

DEQ and the designated WAG will continue to re-evaluate TMDLs on a 5-year cycle. During the 5-year review, implementation actions completed, in progress, and planned will be reviewed, and pollutant load allocations will be reassessed accordingly.

5.6.2 Approach

The TMDLs developed in this document will focus on implementing load allocations for temperature. Implementation plans that have been in place since the original TMDL (DEQ 2005a) have helped inform many watershed improvement projects that have been completed or are ongoing in the Camas Creek subbasin.

5.6.3 Responsible Parties

Idaho Code §39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. DEQ will rely on the designated management agencies to implement pollution control measures or BMPs for those pollutant sources identified as priorities.

DEQ also recognizes the authorities and responsibilities of city and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality.

The designated state agencies listed below are responsible for assisting and providing technical support for developing specific implementation plans and other appropriate support for water quality projects. General responsibilities for Idaho-designated management agencies are as follows:

- Idaho Soil and Water Conservation Commission: grazing and agriculture
- Idaho State Department of Agriculture: aquaculture and animal feeding operations
- Idaho Transportation Department: public roads
- Idaho Department of Lands: timber harvest, oil and gas exploration, and mining
- Idaho Department of Water Resources: stream channel alteration activities
- Idaho Department of Environmental Quality: all other activities

5.6.4 Implementation Monitoring Strategy

Effective shade monitoring can take place on any segment throughout the Camas Creek and be compared to existing shade estimates seen in Figure 5 and described in Table 8–Table 22. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and determine progress toward meeting shade targets. Since many existing shade estimates have not been field verified, they may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

5.6.5 Pollutant Trading

Water quality trading (also known as pollutant trading) is a contractual agreement to exchange pollution reductions between two parties. Water quality trading is a business-like way of helping to solve water quality problems by focusing on cost-effective, local solutions to problems caused by pollutant discharges to surface waters. Water quality trading is one of the tools available to meet reductions called for in a TMDL where point and nonpoint sources both exist in a watershed. For additional information, see Appendix E.

6 Conclusions

Effective shade targets were established for 7 water bodies and 15 AUs based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho's water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table 27.

This addendum to the 2005 temperature TMDL re-examined new aerial imagery and assigned new shade targets based on Idaho plant community data. New loads developed in this review should replace 2005 loads. In general, most stream conditions did not change as a result of the new analysis. Willow Creek is in worse condition and Beaver Creek is in better condition as compared to the original TMDL. All streams examined lack shade to some degree.

Target shade levels for individual stream segments should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts.

Table 27. Summary of assessment outcomes.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Camas Creek	ID17040220SK001_05 ID17040220SK007_05 ID17040220SK013_05 ID17040220SK018_02 ID17040220SK018_03 ID17040220SK018_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Camas Creek	ID17040220SK018_05 (formerly part of 018_02)	Temperature	Yes	Add to Category 4a	New AU# to replace a mislabeled segment
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Willow Creek	ID17040220SK003_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Beaver Creek	ID17040220SK004_02 ID17040220SK004_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Soldier Creek	ID17040220SK011_03 (formerly 011_02)	Temperature	Yes	Change AU# in Category 4a	Excess solar load from a lack of existing shade
Corral Creek	ID17040220SK015_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Wild Horse Creek	ID17040220SK021_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade

This document was prepared with input from the public, as described in Appendix F. Following the public comment period, comments and DEQ responses will also be included in this appendix, and a distribution list will be included in Appendix G.

References Cited

Armantrout, N.B., compiler. 1998. *Glossary of Aquatic Habitat Inventory Terminology*. Bethesda, MD: American Fisheries Society.

Batt, Philip E., Governor. 1996. State of Idaho Bull Trout Conservation Plan. Office of the Governor. Boise.

CFR (Code of Federal Regulation). 1977. "Guidelines Establishing Test Procedures for the Analysis of Pollutants." 40 CFR 136.

CFR (Code of Federal Regulation). 1983. "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System." 40 CFR 122.

CFR (Code of Federal Regulation). 1983. "Water Quality Standards." 40 CFR 131.

CFR (Code of Federal Regulation). 1995. "Water Quality Planning and Management." 40 CFR 130.

DEQ (Idaho Department of Environmental Quality). 2005a. *Camas Creek Subbasin Assessment and Total Maximum Daily Load.* Twin Falls, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/camas-creek-subbasin*.

DEQ (Idaho Department of Environmental Quality). 2005b. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/wastewater/stormwater*.

DEQ (Idaho Department of Environmental Quality). 2010. *Water Quality Pollutant Trading Guidance.* Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/pollutant-trading*.

DEQ (Idaho Department of Environmental Quality). 2014. *Idaho's 2012 Integrated Report*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/monitoring-assessment/integrated-report*.

DEQ (Idaho Department of Environmental Quality). 2015. *Idaho Nonpoint Source Management Plan*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/nonpoint-source-pollution/idahos-nps-management-program*.

DEQ (Idaho Department of Environmental Quality). 2016. *Camas Creek Subbasin Five-Year Review.* Twin Falls, ID: DEQ.

EPA (US Environmental Protection Agency). 1996. *Biological Criteria: Technical Guidance for Streams and Small Rivers*. Washington DC: EPA, Office of Water. EPA 822-B-96-001.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. *Water Body Assessment Guidance.* 2nd ed. Boise, ID: Department of Environmental Quality. 114 p.

Idaho Code. 2015. “Integration of Total Maximum Daily Load Processes With Other Programs.” Idaho Code 39-3612.

Idaho Code. 2015. “Investigation -- Inspection -- Right of entry -- Violation -- Enforcement -- Penalty -- Injunctions.” Idaho Code 39-108.

IDAPA. 2015. “Dredge and Placer Mining Operations in Idaho.” Idaho Administrative Code. IDAPA 20.03.01.

IDAPA. 2015. “Idaho Water Quality Standards.” Idaho Administrative Code. IDAPA 58.01.02.

IDAPA. 2015. “Individual/Subsurface Sewage Disposal Rules.” Idaho Administrative Code. IDAPA 58.01.03.

IDAPA. 2015. “Rules Governing Dairy Waste.” Idaho Administrative Code. IDAPA 02.04.14.

IDAPA. 2015. “Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities.” Idaho Administrative Code. IDAPA 20.03.02.

IDAPA. 2015. “Rules Pertaining to the Idaho Forest Practices Act.” Idaho Administrative Code. IDAPA 20.01.01.

IDAPA. 2015. “Solid Waste Management Rules and Standards.” Idaho Administrative Code. IDAPA 58.01.06.

IDAPA. 2015. “Stream Channel Alteration Rules.” Idaho Administrative Code. IDAPA 37.03.07.

IDL (Idaho Department of Lands). 2000. *Forest Practices Cumulative Watershed Effects Process for Idaho*. Boise, ID: IDL.

ISWCC. 2015. *Idaho Agricultural Pollution Abatement Plan.* Boise, ID: Idaho Soil and Water Conservation Commission.

Küchler, A.U. 1964. “Potential Natural Vegetation of the Conterminous United States.” American Geographical Society Special Publication 36.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2001. “Ecoregions of Idaho.” Reston, VA: US Geological Survey.

OWEB (Oregon Watershed Enhancement Board). 2001. “Stream Shade and Canopy Cover Monitoring Methods.” In *Water Quality Monitoring Technical Guide Book,* chap. 14. Salem, OR: OWEB.

Poole, G.C., and C.H. Berman. 2001. “An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation.” *Environmental Management* 27(6):787–802.

Shumar, M.L. and J. De Varona. 2009. *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual*. Boise, ID: Idaho Department of Environmental Quality.

Strahler, A.N. 1957. "Quantitative Analysis of Watershed Geomorphology." *Transactions American Geophysical Union* 38:913–920.

US Congress. 1972. Clean Water Act (Federal Water Pollution Control Act). 33 USC §1251–1387.

Willamette Partnership et al. (Willamette Partnership, The Freshwater Trust, Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, and Washington Department of Ecology). 2014. *Draft Regional Recommendations for the Pacific Northwest on Water Quality Trading*. *http://willamettepartnership.org/wp-content/uploads/2014/09/PNW-Joint-Regional-Recommendations-on-WQT_ThirdDraft_2014-08-05_full1.pdf*.

GIS Coverages

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USDA – FSA Aerial Photography Field Office - 2013 National Agricultural Imagery Program (NAIP) 0.5m imagery

USDA – FSA Aerial Photography Field Office - 2011 National Agricultural Imagery Program (NAIP) 1.0m imagery

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Glossary

§303(d)

Refers to section 303 subsection "d" of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to US Environmental Protection Agency approval.

Ambient

General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).

Anthropogenic

Relating to, or resulting from, the influence of human beings on nature.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.

Beneficial Use

Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, that are recognized in water quality standards.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, wadeable streams, and rivers.

Exceedance

A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Load Allocation (LA)

A portion of a water body's load capacity for a given pollutant that is allocated to a particular nonpoint source (by class, type, or geographic area).

Load(ing)

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.

Load Capacity (LC)

How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's loading capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.

Natural Condition

The condition that exists with little or no anthropogenic influence.

Nonpoint Source

A dispersed source of pollutants generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point of origin. They include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete a use support assessment.

Not Fully Supporting

Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Point Source

A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

Pollutant

Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution

A very broad concept that encompasses human-caused changes in the environment that alters the functioning of natural processes and produce undesirable environmental and health effects. These changes include human-induced alterations of the physical, biological, chemical, and radiological integrity of water and other media.

Potential Natural Vegetation (PNV)

A.U. Küchler (1964) defined potential natural vegetation as vegetation that would exist without human interference and if the resulting plant succession were projected to its climax condition while allowing for natural disturbance processes such as fire. Our use of the term reflects Küchler's definition in that riparian vegetation at PNV would produce a system potential level of shade on streams and includes recognition of some level of natural disturbance.

Reasonable Assurance

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

Riparian

Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

Stream Order

Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from the joining of two streams of the same order.

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Quality Criteria

Levels of water quality expected to render a water body suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Standards

State-adopted and US Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Appendix A. Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses.

Existing Uses

Existing uses under the Clean Water Act are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

Designated Uses

Designated uses under the Clean Water Act are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

Undesignated Surface Waters

In Idaho, due to a change in scale of cataloging waters in 2000, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations (IDAPA 58.01.02.110–160). These undesignated surface waters ultimately need to be designated for appropriate uses. In the interim, and absent information on existing uses, DEQ presumes most of these waters will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called presumed uses, DEQ applies the cold water and recreation use criteria to undesignated waters. If in addition to presumed uses, an additional existing use (e.g., salmonid spawning) exists, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature) because of the requirement to protect water quality for that existing use. However, if some other use that requires less stringent criteria for protection (such as seasonal cold water aquatic life) is found to be an existing use, then a use designation (rulemaking) is needed before that use can be applied in lieu of cold water criteria.

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Appendix B. State and Site-Specific Water Quality Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies by species. For spring-spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally March 15 to July 15 (Grafe et al. 2002). Fall spawning can occur as early as September 1 and continue with incubation into the following spring up to June 1. As per IDAPA 58.01.02.250.02.f.ii., the following water quality criteria need to be met during that time period:

- 13 °C as a daily maximum water temperature
- 9 °C as a daily average water temperature

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of the highest annual maximum weekly maximum air temperatures) is compared to the daily maximum criterion of 13 °C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during certain time periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply:

> When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401. (IDAPA 58.01.02.200.09)

Section 401 relates to point source wastewater treatment requirements. In this case, if temperature criteria for any aquatic life use are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.01.c).

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Appendix C. Data Sources and Other Data

Table C1. Data sources for Camas Creek subbasin assessment.

Water Body	Data Source	Type of Data	Collection Date
Camas Creek watershed	DEQ Twin Falls Regional Office and DEQ Technical Services	Solar Pathfinder effective shade and stream width	October 2014
	DEQ Technical Services	Aerial photo interpretation of existing shade and stream width estimation	September 2014
	DEQ IDASA database	Temperature	2015

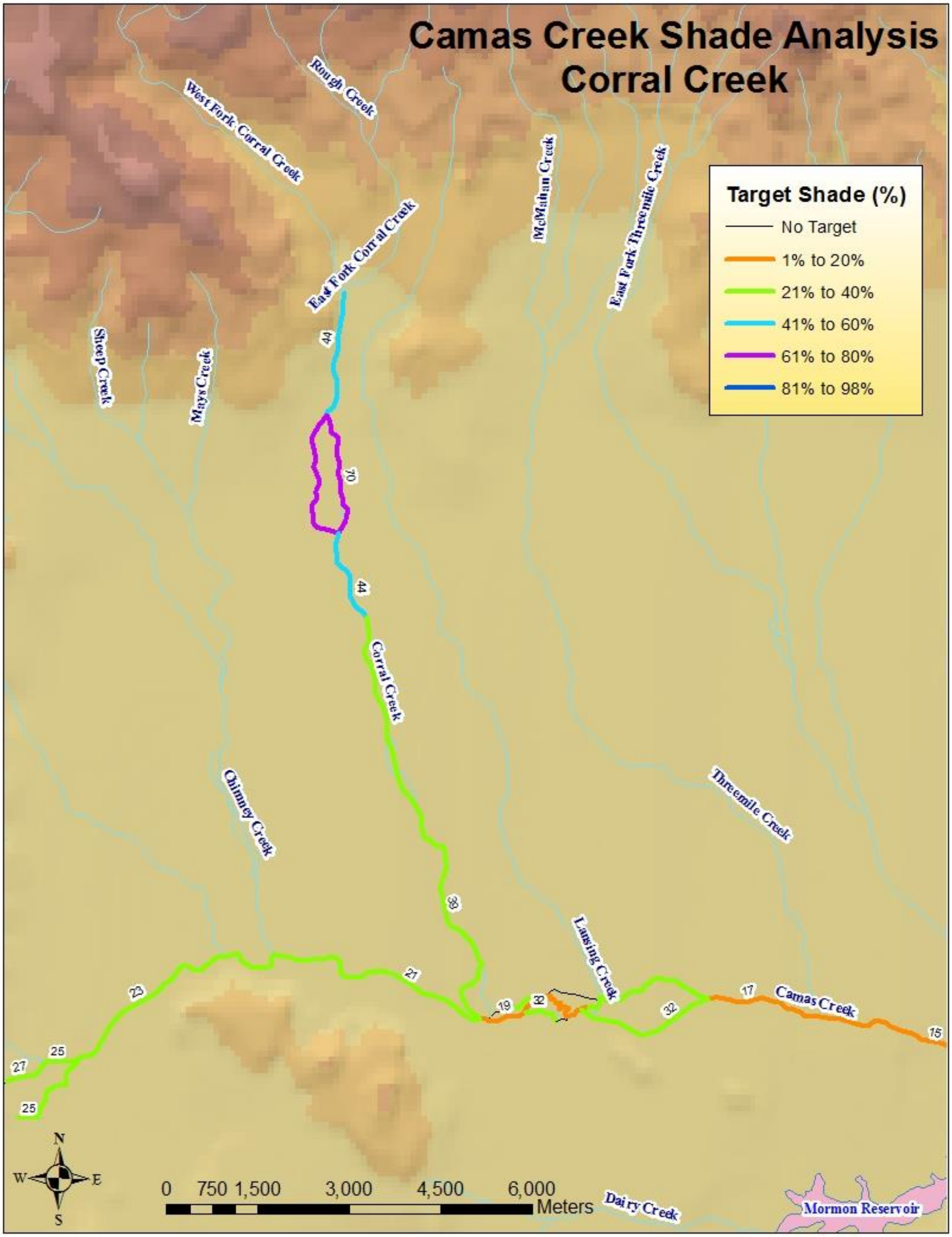

Figure C-1. Target shade for the Corral Creek watershed.

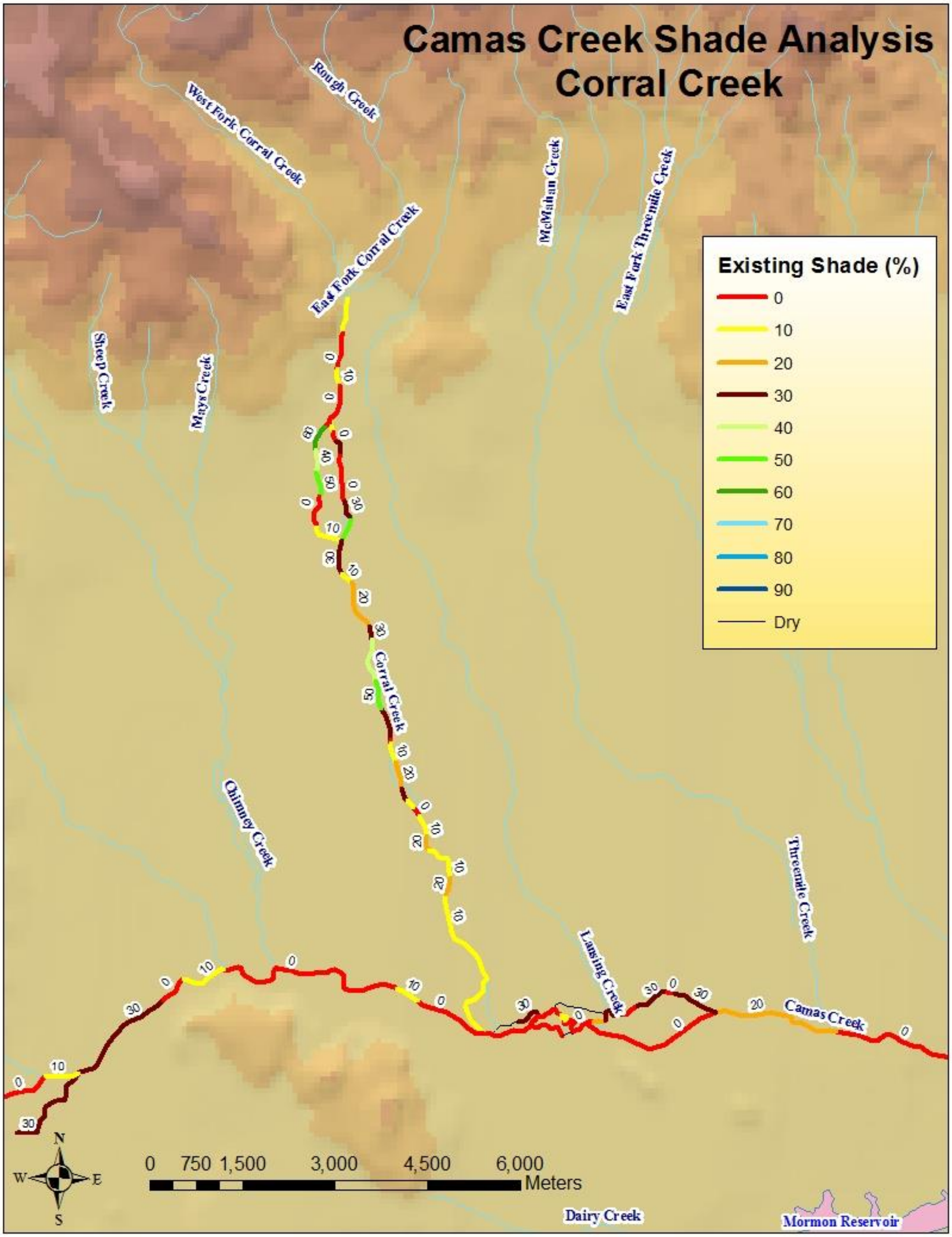

Figure C-2. Existing shade estimated for the Corral Creek watershed by aerial photo interpretation.

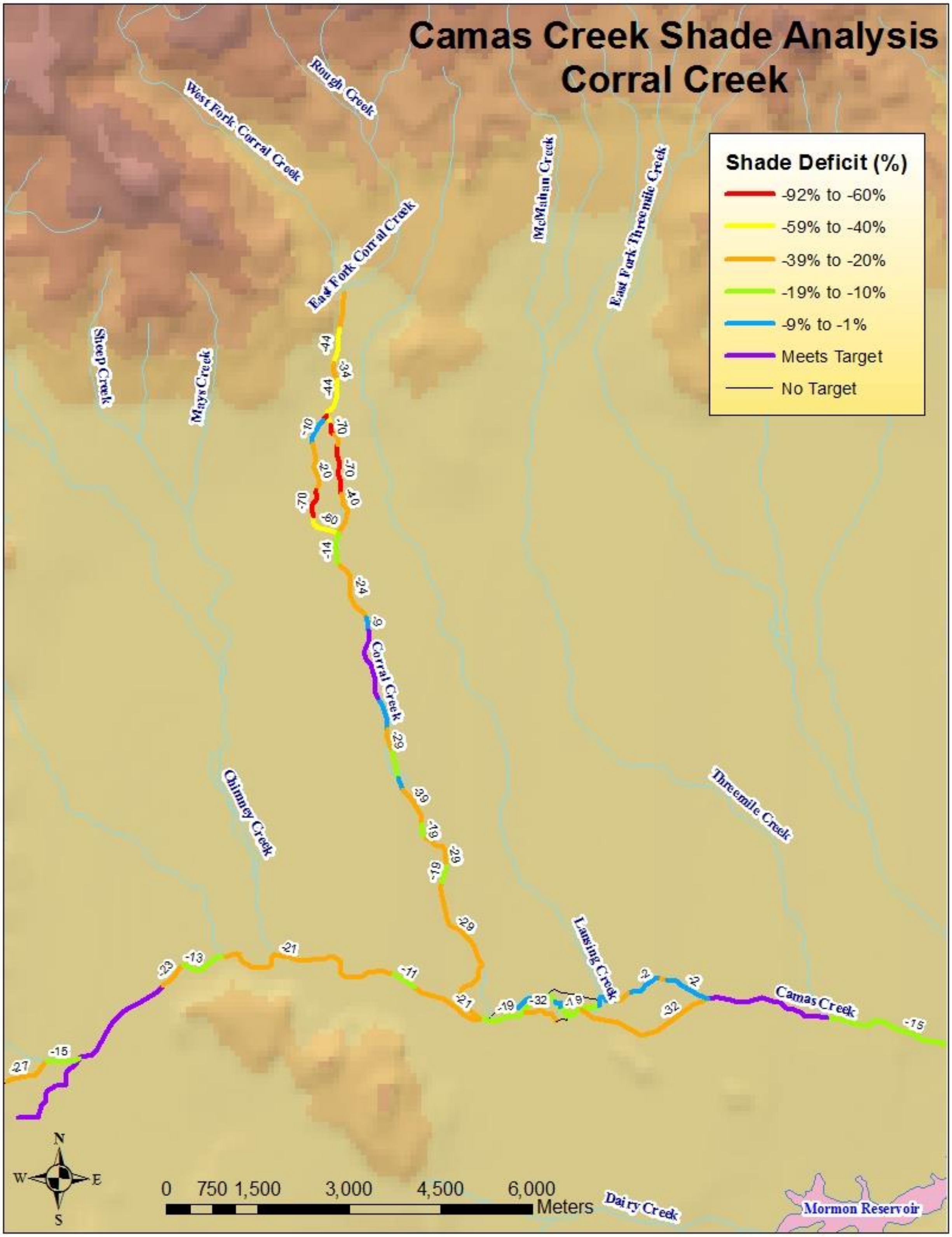

Figure C-3. Shade deficit (difference between existing and target) for the Corral Creek watershed.

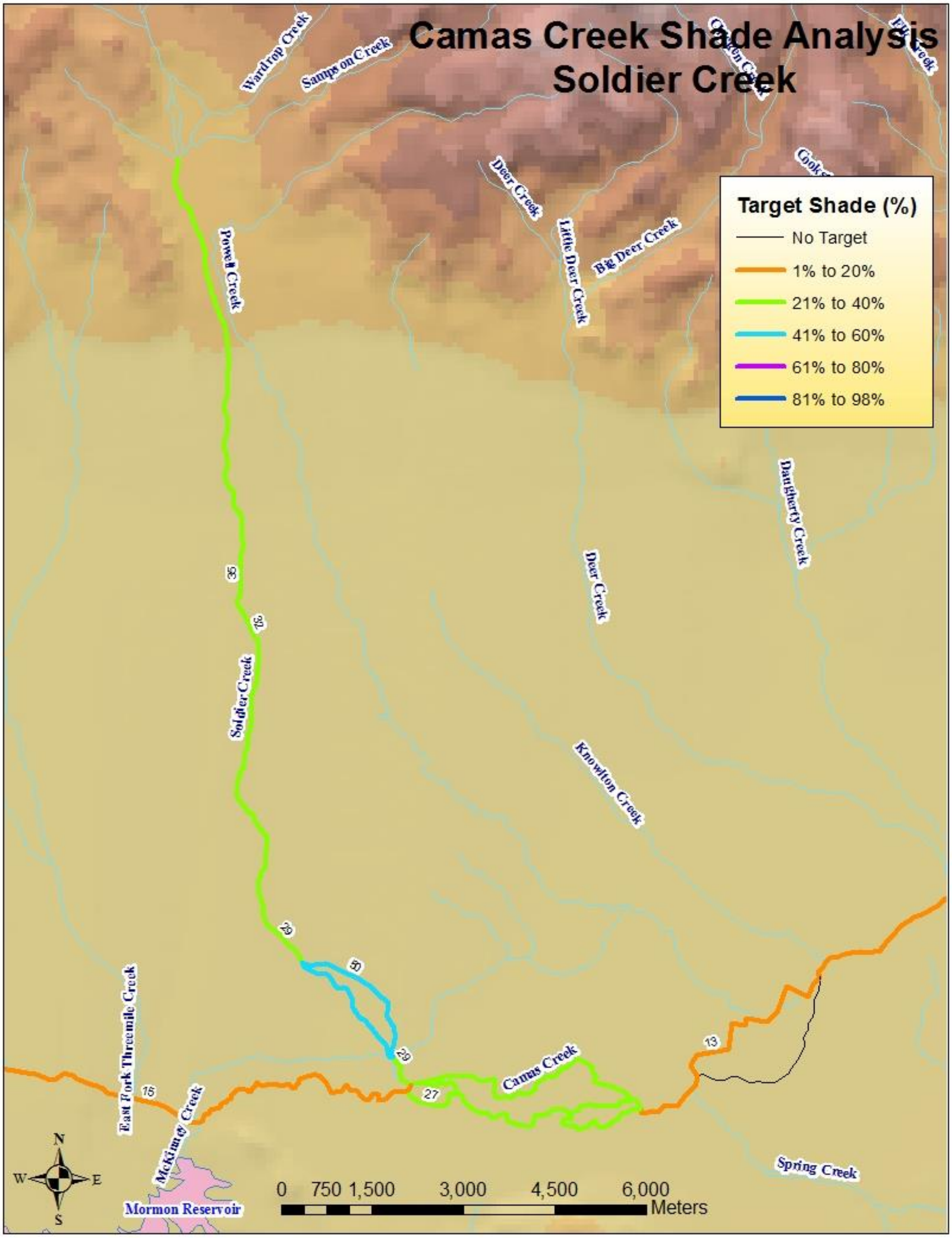

Figure C-4. Target shade for the Soldier Creek watershed.

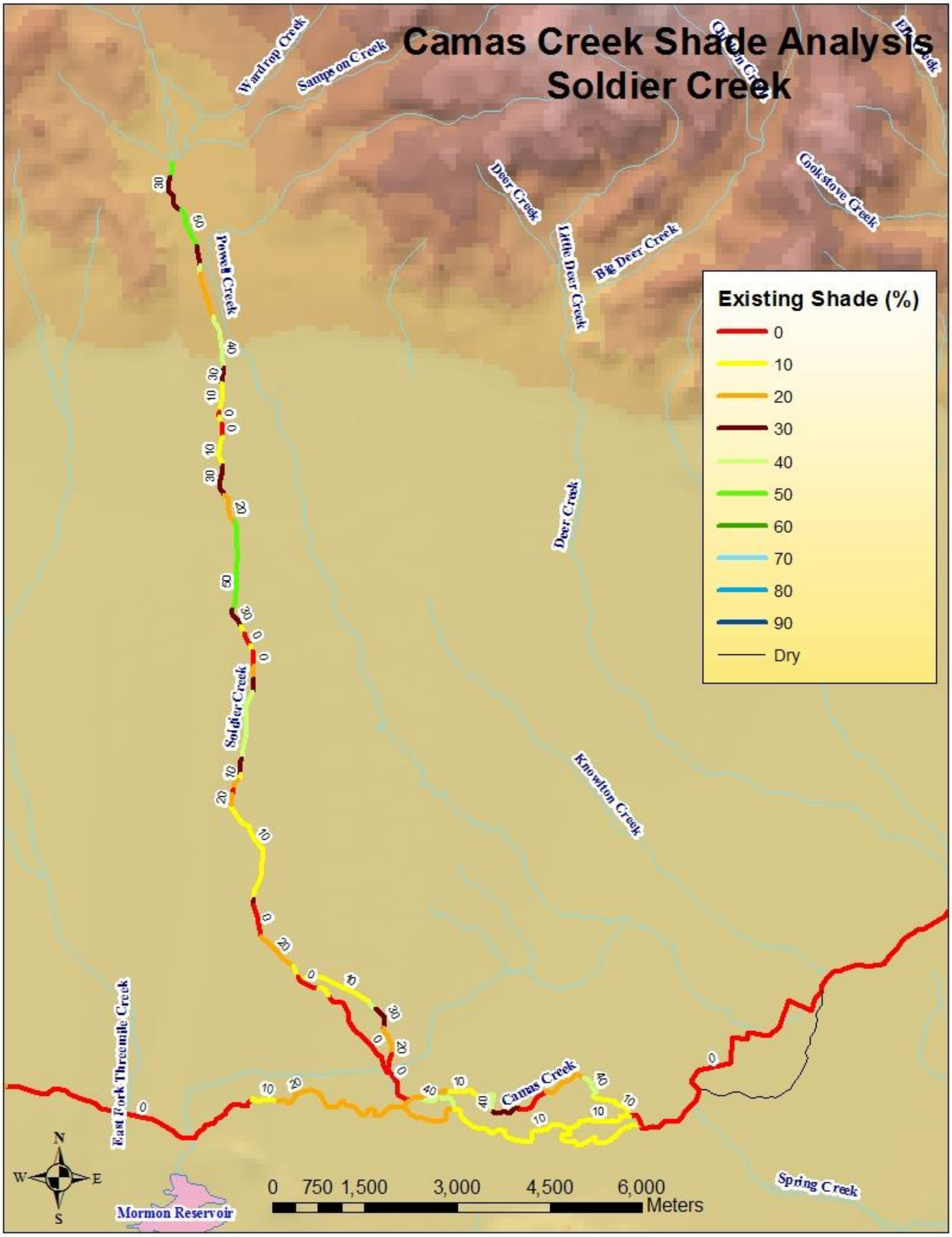

Figure C-5. Existing shade estimated for the Soldier Creek watershed by aerial photo interpretation.

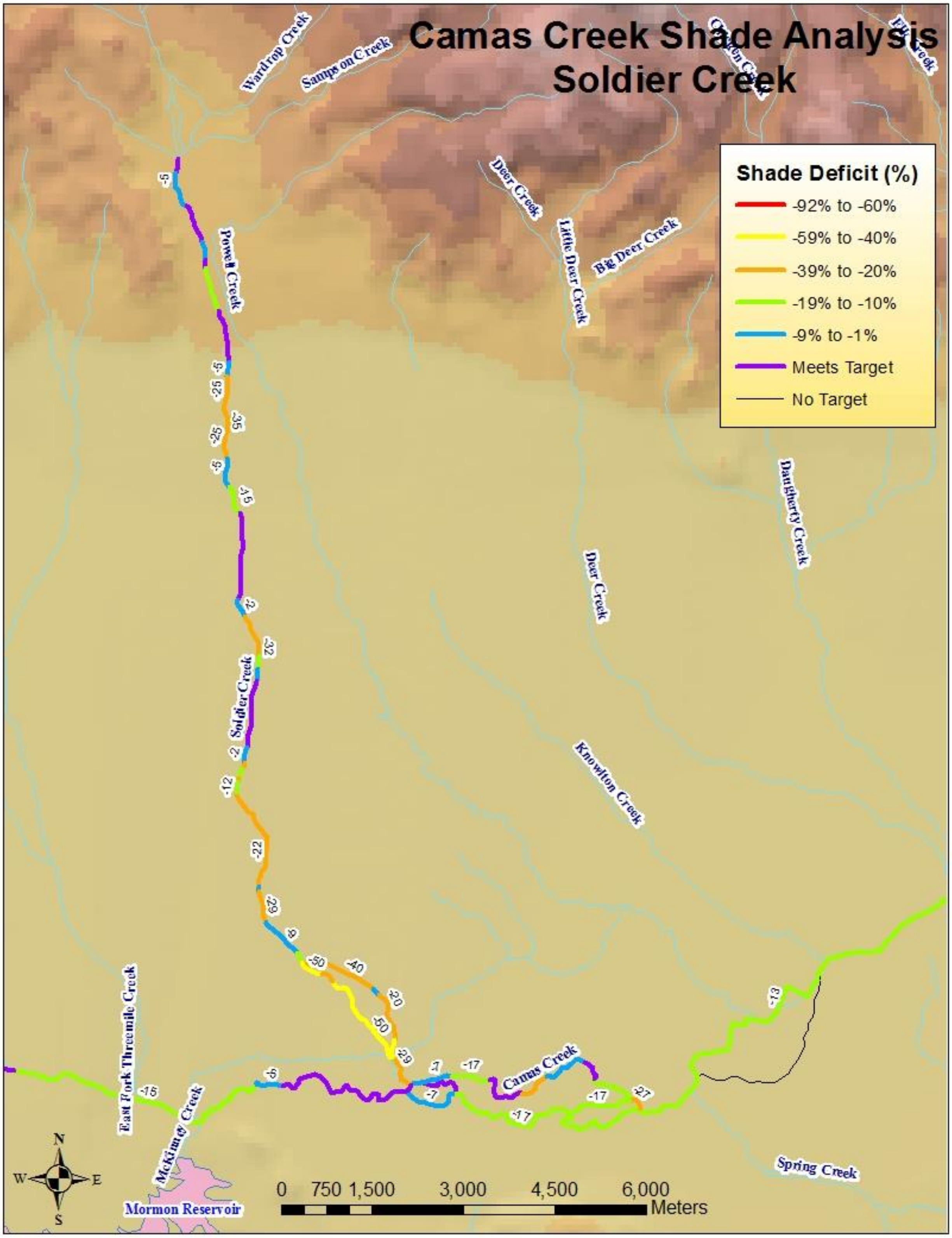

Figure C-6. Shade deficit (difference between existing and target) for the Soldier Creek watershed.

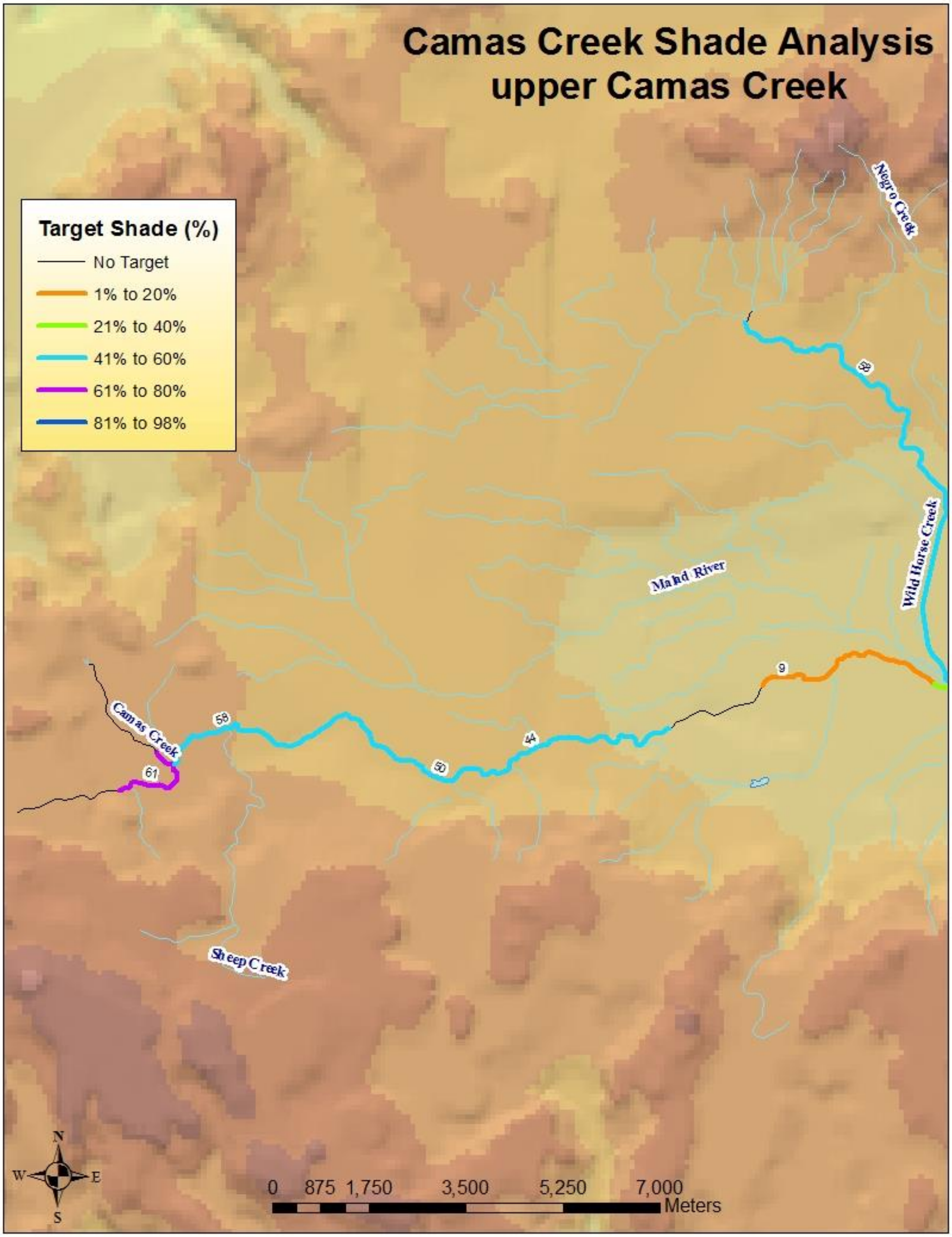

Figure C-7. Target shade for the upper Camas Creek watershed.

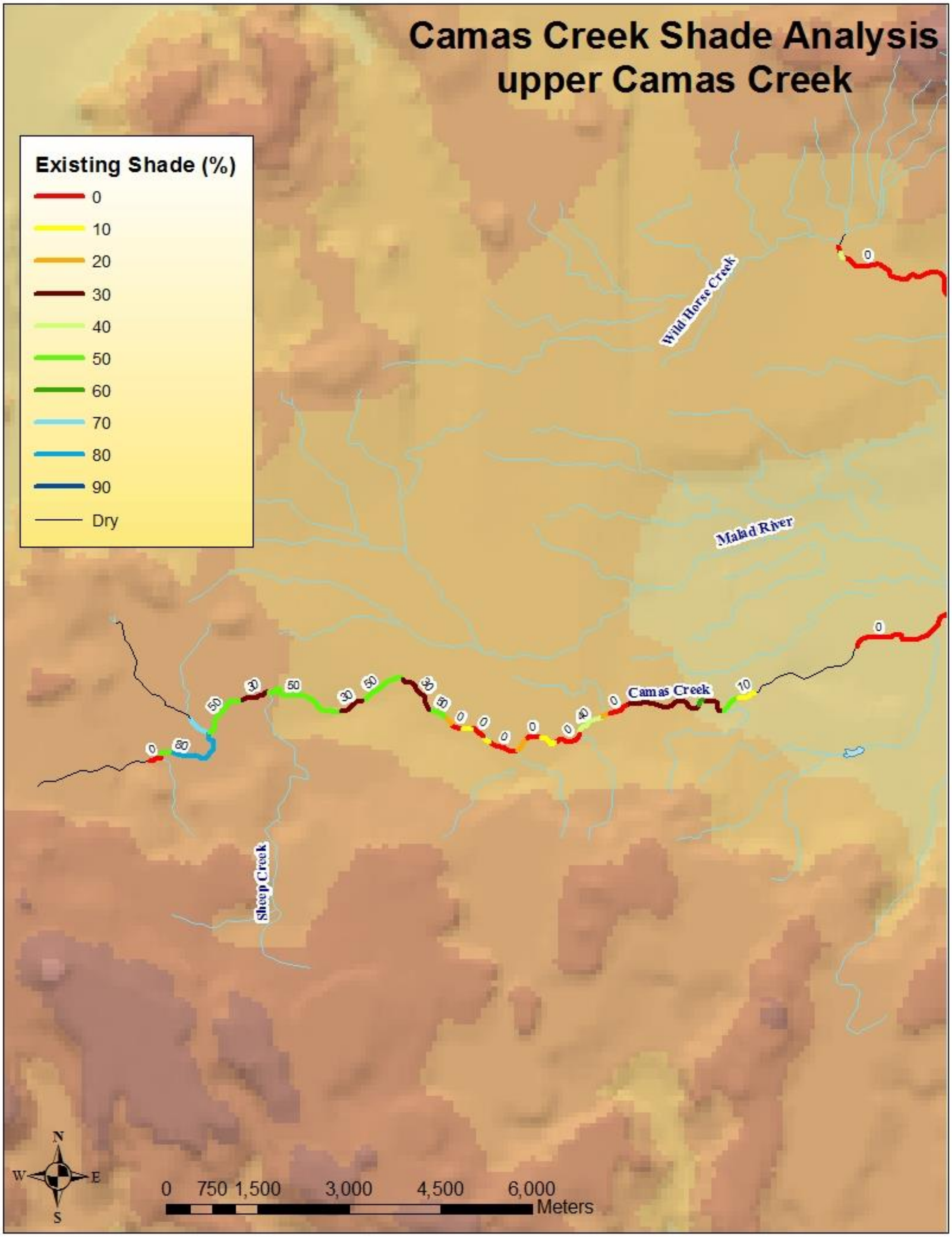

Figure C-8. Existing shade estimated for the upper Camas Creek watershed by aerial photo interpretation.

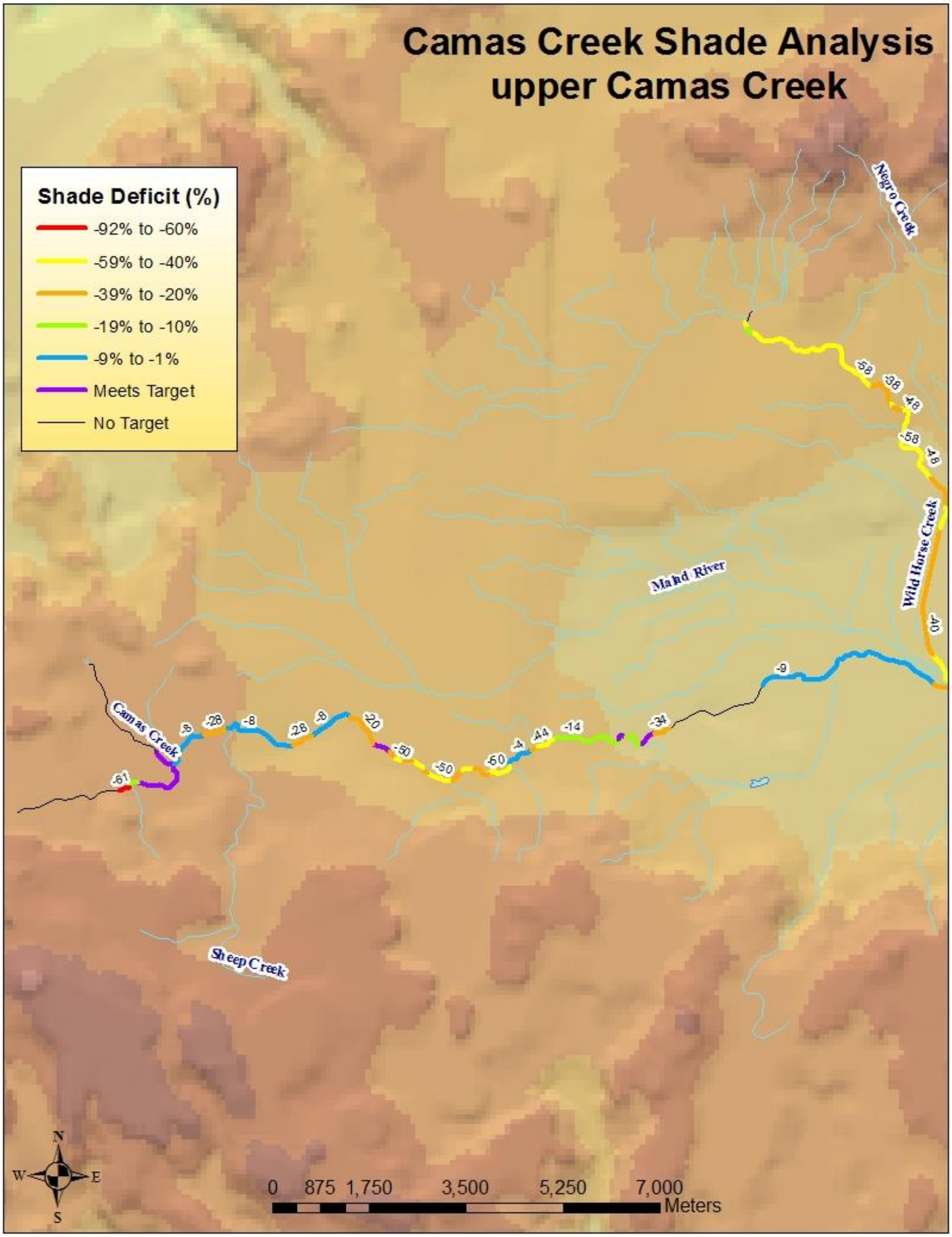

Figure C-9. Shade deficit (difference between existing and target) for the upper Camas Creek watershed.

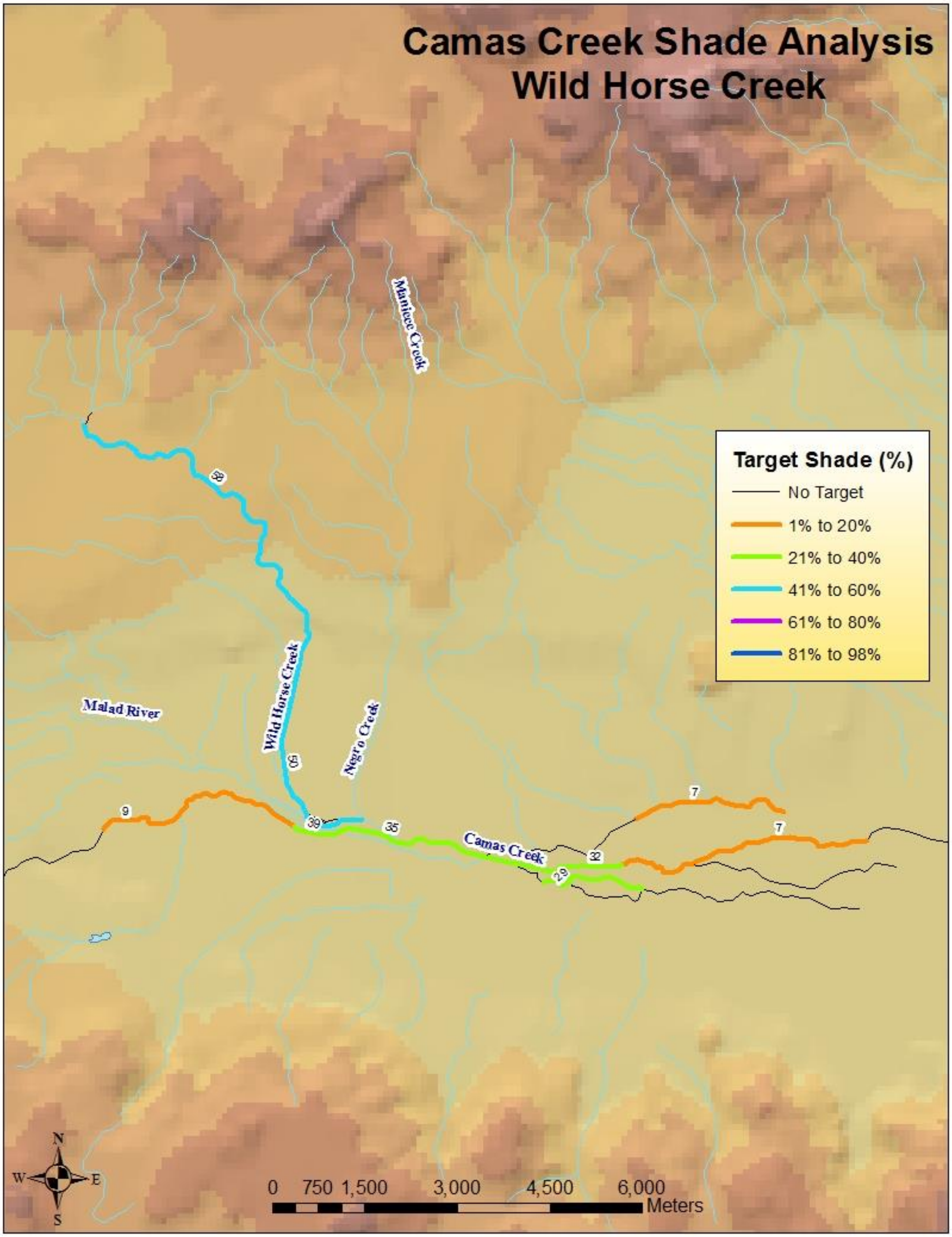

Figure C-10. Target shade for the Wild Horse Creek watershed.

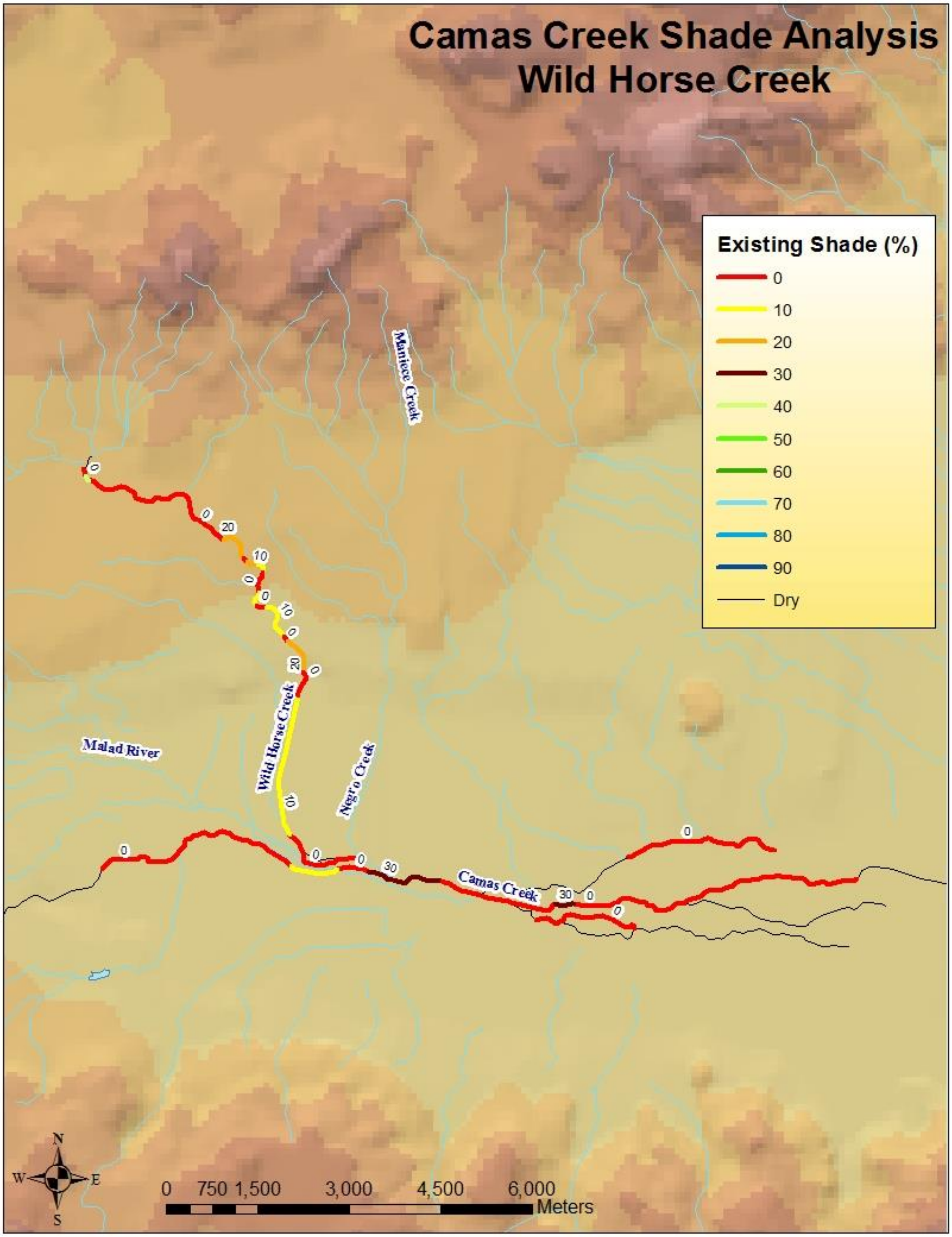

Figure C-11. Existing shade estimated for the Wild Horse Creek watershed by aerial photo interpretation.

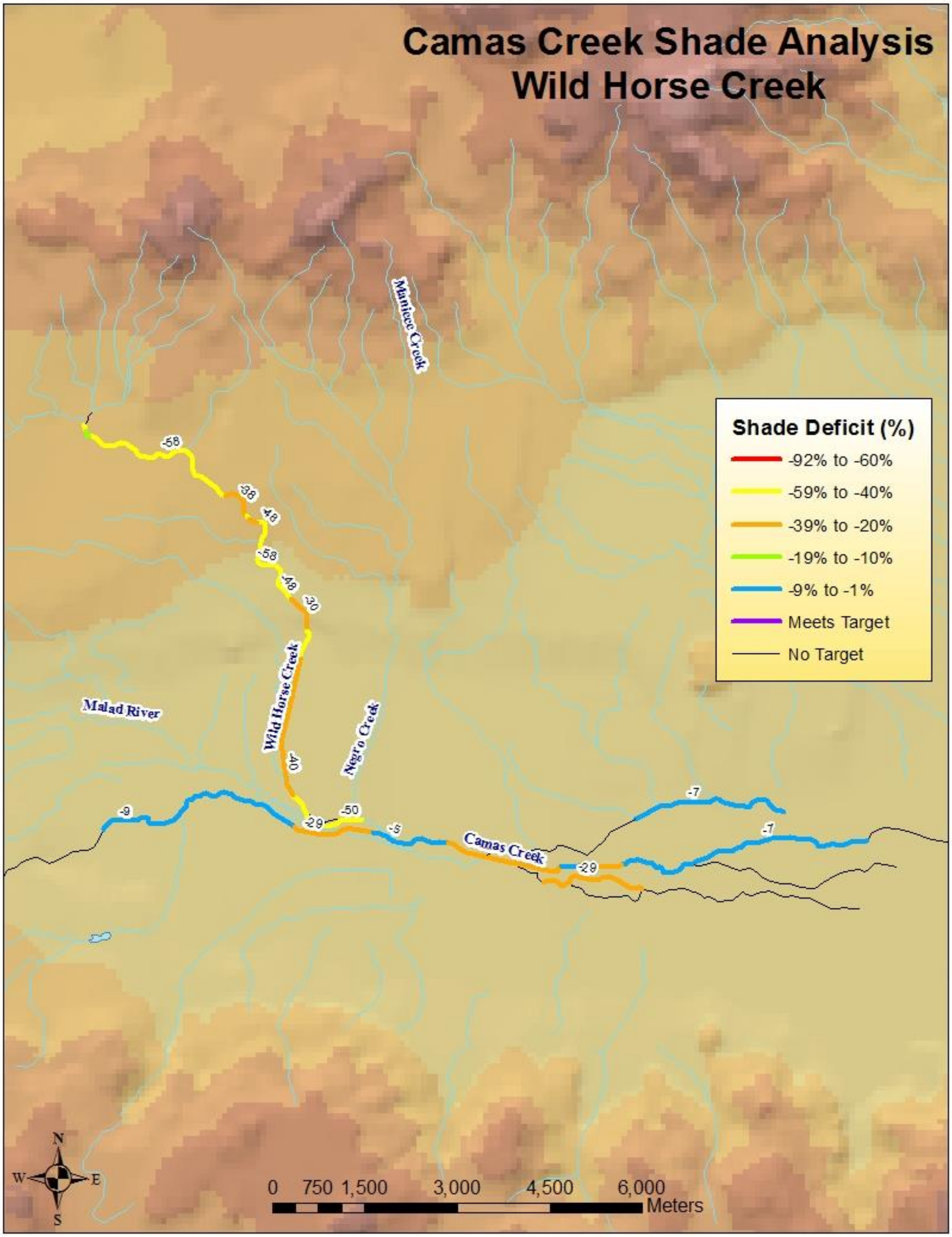

Figure C-12. Shade deficit (difference between existing and target) for the Wild Horse Creek watershed.

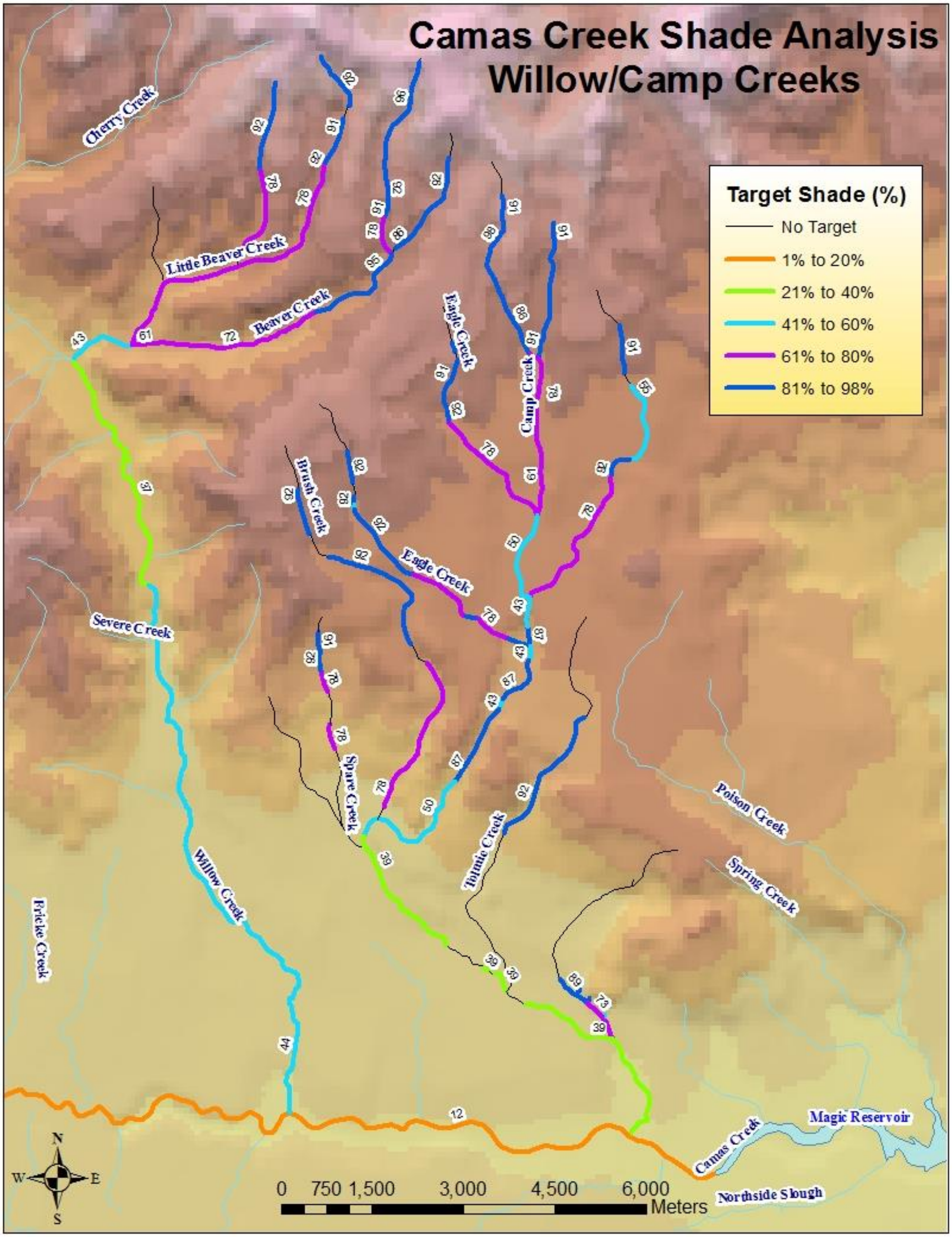

Figure C-13. Target shade for the Willow/Camp Creeks watersheds.

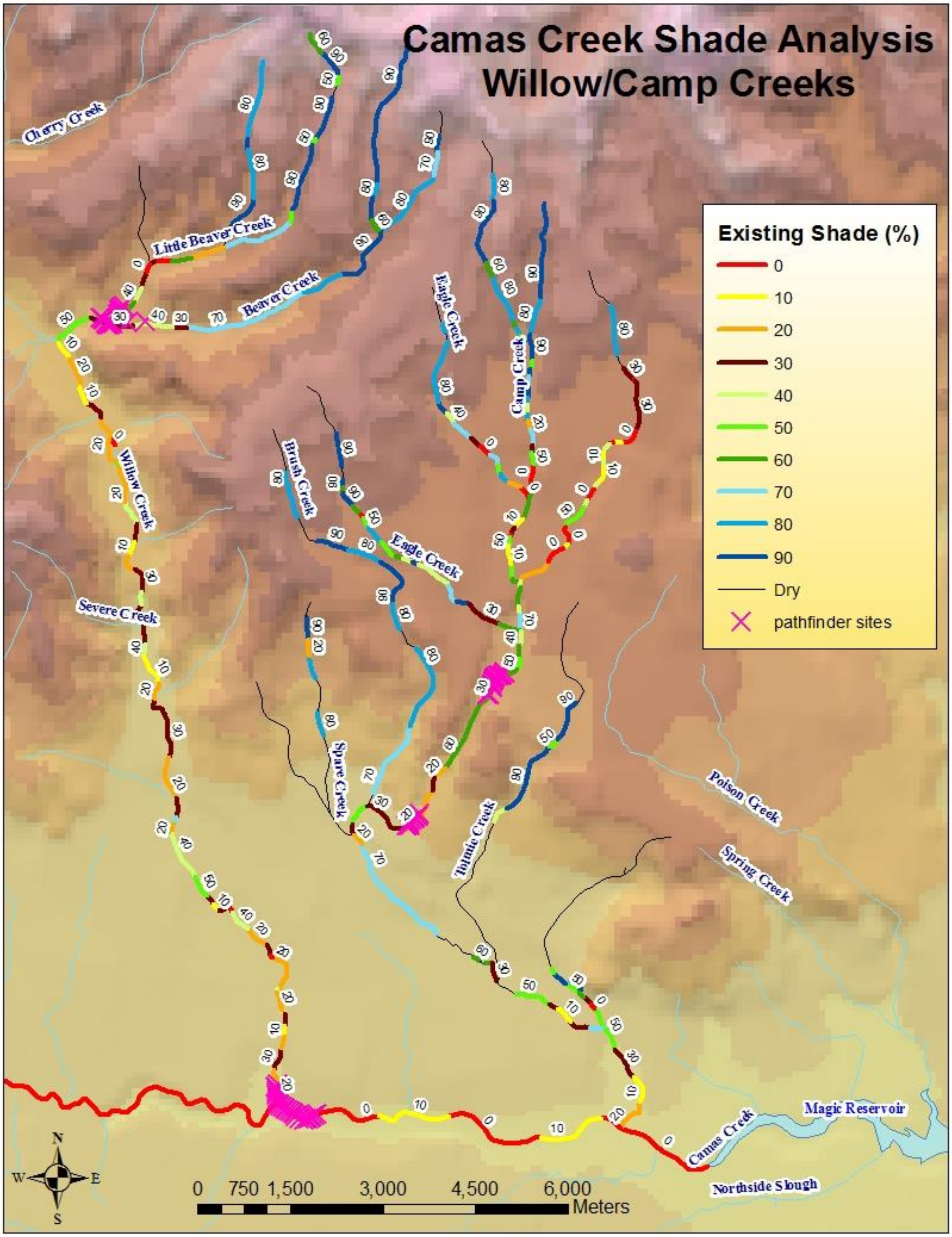

Figure C-14. Existing shade estimated for the Willow/Camp Creeks watersheds by aerial photo interpretation.

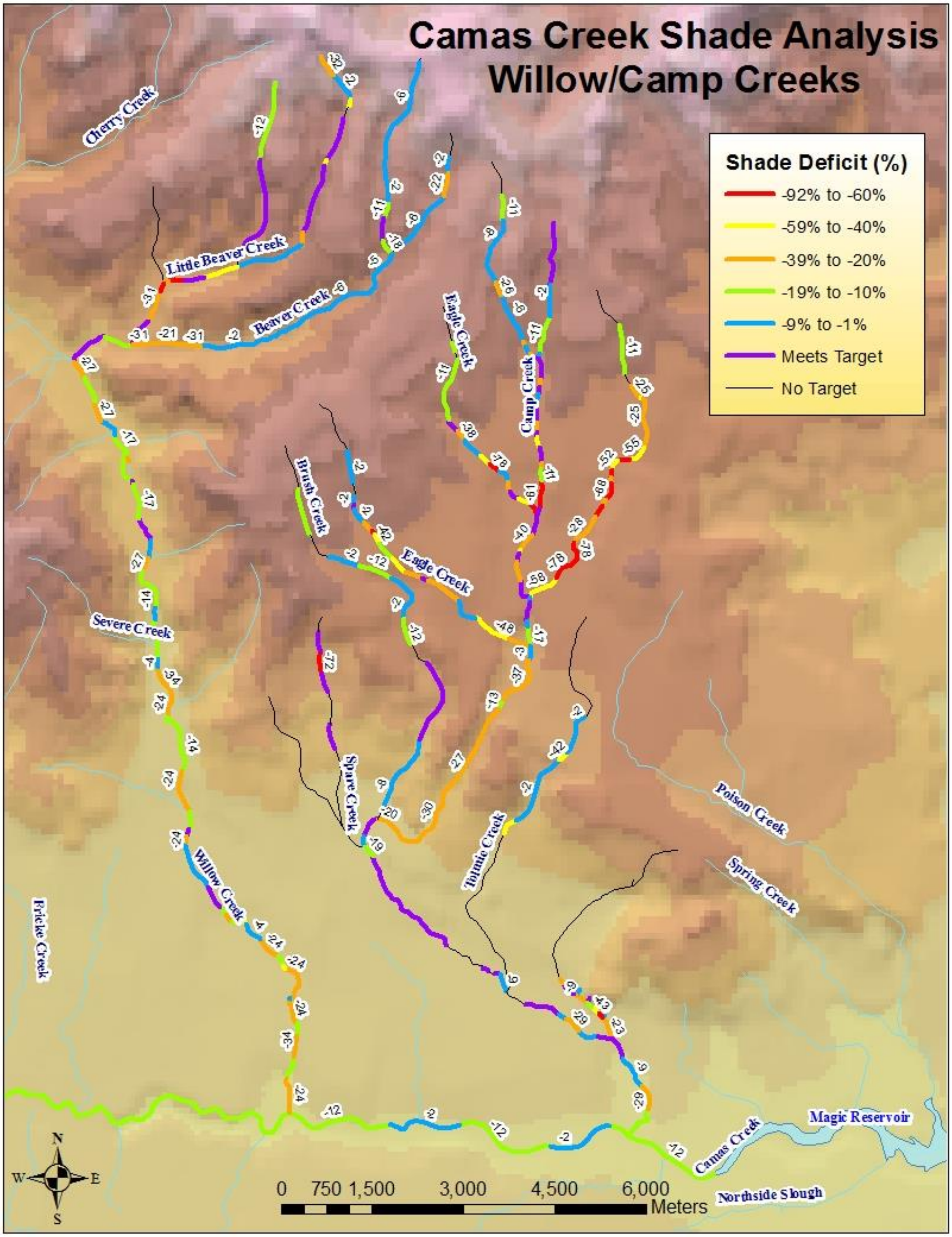

Figure C-15. Shade deficit (difference between existing and target) for the Willow/Camp Creeks watersheds.

Appendix D. Managing Stormwater

Municipal Separate Storm Sewer Systems

Polluted stormwater runoff is commonly transported through municipal separate storm sewer systems (MS4s), from which it is often discharged untreated into local water bodies. An MS4, according to 40 CFR 122.26(b)(8), is a conveyance or system of conveyances that meets the following criteria:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the US
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.)
- Not a combined sewer
- Not part of a publicly owned treatment works (sewage treatment plant)

To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain an National Pollutant Discharge Elimination System (NPDES) permit from the US Environmental Protection Agency (EPA), implement a comprehensive municipal stormwater management program (SWMP), and use best management practices (BMPs) to control pollutants in stormwater discharges to the maximum extent practicable.

Industrial Stormwater Requirements

Stormwater runoff picks up industrial pollutants and typically discharges them into nearby water bodies directly or indirectly via storm sewer systems. When facility practices allow exposure of industrial materials to stormwater, runoff from industrial areas can contain toxic pollutants (e.g., heavy metals and organic chemicals) and other pollutants such as trash, debris, and oil and grease. This increased flow and pollutant load can impair water bodies, degrade biological habitats, pollute drinking water sources, and cause flooding and hydrologic changes, such as channel erosion, to the receiving water body.

Multi-Sector General Permit and Stormwater Pollution Prevention Plans

In Idaho, if an industrial facility discharges industrial stormwater into waters of the US, the facility must be permitted under EPA's most recent Multi-Sector General Permit (MSGP). To obtain an MSGP, the facility must prepare a stormwater pollution prevention plan (SWPPP) before submitting a notice of intent for permit coverage. The SWPPP must document the site description, design, and installation of control measures; describe monitoring procedures; and summarize potential pollutant sources. A copy of the SWPPP must be kept on site in a format that is accessible to workers and inspectors and be updated to reflect changes in site conditions, personnel, and stormwater infrastructure.

Industrial Facilities Discharging to Impaired Water Bodies

Any facility that discharges to an impaired water body must monitor all pollutants for which the water body is impaired and for which a standard analytical method exists (see 40 CFR Part 136).

Also, because different industrial activities have sector-specific types of material that may be exposed to stormwater, EPA grouped the different regulated industries into 29 sectors, based on their typical activities. Part 8 of EPA's MSGP details the stormwater management practices and monitoring that are required for the different industrial sectors. EPA issued a new MSGP in December 2013. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification. The new MSGP details the specific monitoring requirements.

TMDL Industrial Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a wasteload allocation for industrial stormwater activities under the MSGP. However, most load analyses developed in the past have not identified sector-specific numeric wasteload allocations for industrial stormwater activities. Industrial stormwater activities are considered in compliance with provisions of the TMDL if operators obtain an MSGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The next MSGP will have specific monitoring requirements that must be followed.

Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites.

Construction General Permit (CGP) and Stormwater Pollution Prevention Plans

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a CGP from EPA after developing a site-specific SWPPP. The SWPPP must provide for the erosion, sediment, and pollution controls they intend to use; inspection of the controls periodically; and maintenance of BMPs throughout the life of the project. Operators are required to keep a current copy of their SWPPP on site or at an easily accessible location.

TMDL Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed.

Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005b) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those are applicable.

Appendix E. Pollutant Trading

Pollutant trading (also known as water quality trading) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective, local solutions to problems caused by pollutant discharges to surface waters. Pollutant trading is one of the tools available to meet reductions called for in a TMDL where point and nonpoint sources both exist in a watershed.

The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

Pollutant trading is voluntary. Parties trade only if both are better off because of the trade, and trading allows parties to decide how to best reduce pollutant loadings within the limits of certain requirements.

Pollutant trading is recognized in Idaho's water quality standards at IDAPA 58.01.02.055.06. DEQ allows for pollutant trading as a means to meet TMDLs, thus restoring water quality limited water bodies to compliance with water quality standards. DEQ's *Water Quality Pollutant Trading Guidance* sets forth the procedures to be followed for pollutant trading (DEQ 2010). This guidance is under revision, which should be available by end of calendar year 2016.

Trading Components

The major components of pollutant trading are trading parties (buyers and sellers) and credits (the commodity being bought and sold). Ratios are used to ensure environmental equivalency of trades on water bodies covered by a TMDL. All trading activity must be recorded in the trading database by DEQ or its designated party.

Both point and nonpoint sources may create marketable credits, which are a reduction of a pollutant beyond a level set by a TMDL:

- Point sources create credits by reducing pollutant discharges below NPDES effluent limits set initially by the wasteload allocation.
- Nonpoint sources create credits by implementing approved BMPs that reduce the amount of pollutant runoff. Nonpoint sources must follow specific design, maintenance, and monitoring requirements for that BMP; apply discounts to credits generated, if required; and provide a water quality contribution to ensure a net environmental benefit. The water quality contribution also ensures the reduction (the marketable credit) is surplus to the reductions the TMDL assumes the nonpoint source is achieving to meet the water quality goals of the TMDL.

Watershed-Specific Environmental Protection

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL is protected. To do this, hydrologically based ratios are developed to ensure trades between sources distributed throughout TMDL water bodies result in environmentally equivalent or better outcomes at the point of environmental concern. Moreover, localized adverse impacts to water quality are not allowed.

Trading Framework

For pollutant trading to be authorized, it must be specifically mentioned within a TMDL document. After adoption of an EPA-approved TMDL, DEQ, in concert with the WAG, may develop a pollutant trading framework document. The framework would mesh with the implementation plan for the watershed that is the subject of the TMDL. Any approved trade must be incorporated into an issued NPDES permit for authorization. The elements of a trading document are described in DEQ’s pollutant trading guidance (DEQ 2010).

Trading Authorization

Water quality trading is authorized in the Idaho water quality standards (IDAPA 58.01.02.055). Trading should be implemented consistent with the Clean Water Act and other existing regulations, EPA's water quality trading policy (EPA 2003), DEQ's water quality trading guidance (DEQ 2010a), or subsequent versions.

After adoption of an EPA-approved TMDL, DEQ, in concert with the WAG, may develop a water quality trading framework document. The Camas Creek subbasin does not have an existing trading framework, but if one should be developed, it should reflect ratios and policies consistent with this TMDL and the Joint Regional Recommendations (JRR) for water quality trading (Willamette Partnership et al. 2014). The JRR were developed as a joint effort between Idaho, Oregon, and Washington, with technical oversight from EPA Region 10 and facilitated through a US Department of Agriculture–Natural Resources Conservation Service Conservation Innovation Grant awarded to the Willamette Partnership. The framework will mesh with the implementation plan. The elements of a trading document are described in DEQ’s water quality trading guidance (DEQ 2010a) or subsequent versions.

Appendix F. Public Participation and Public Comments

This TMDL addendum was developed with participation from the Wood River Valley Watershed Advisory Group (WAG). A 30-day public comment period was conducted from July 29, 2016 to August 29, 2016.

Camas Creek Subbasin Temperature (PNV) TMDL

Response to Public Comments

Jim Paxton Comments: "As I indicated when we visited on the phone I feel that part of the problem is related to the high and over population of Beavers and the number growing rapidly. Building the Dams causing less flow and water to sit idle coupled with taking out the trees along the bank are causing the streams to be way less shaded. We have had to remove Dams on our property that when the water table rises causes flooding and further erosion. We have worked with a Trapper and he with Fish & Game to remove the Beavers and place elsewhere in the state they are welcome. It is my understanding Beavers were planted in the area and are not native to this area. If DEQ could work with the Conservancy and Fish and Game to remove the Beavers it is of my belief would help keep the rise of temperatures and lower the temperatures to product the aquatic life and more."	**DEQ Response:** DEQ appreciates the comments from local land owners. We understand that beavers can expose larger surface areas of water to the sun and can wreak havoc on woody riparian vegetation, especially newly established vegetation. Conversely, we are aware that beaver dams tend to retain more water in floodplains and increase water tables counteracting stream down-cutting. But, DEQ is not a land management agency and cannot provide adequate advice regarding beavers in particular streams. We defer judgement to agencies such as the Idaho Soil and Water Conservation Commission, Soil and Water Conservation Districts, NRCS, BLM, and the Forest Service.
John Moline Comments: "Jim Paxton called our attention to the request of the DEQ seeking comments on their proposed plans for temperature control in various bodies of water. We would be affected by the Camas Creek drainage and our input/comments would be in complete agreement with our neighbor, Jim Paxton's comments he submitted to Mark Shumar regarding the beaver, which is: "That our theory is the Beaver Dams backing up the water and causing the water to sit idle could be causing the water temperature to rise." I was born and raised in Camas County, and my	**DEQ Response:** DEQ encourages land owners to contact the afore mentioned agencies for advice on beaver activity (see response to Jim Paxton Comments).

years spent on Soldier Creek involved a lot of walking from the Pioneer Picnic grounds to Phillips Creek drainage and in those years there were no beaver or beaver ponds. As noted by Jim Paxton the beaver were transplanted into Soldier Creek during the Stapp/Conservancy era. We feel the problem is definitely the beavers and the solution is for the State to remove the Beaver problem. Thus allowing more growth of trees and shrubs along Soldier Creek giving shade and lowering temperature of the waters.	
James W. Austin Comments: "Higher water temperatures are happening all over Southern Idaho. I was recently backpacking in the Hellroaring Drainage of the Sawtooth Mtn. Range and temperatures at 9000 ft. Plus were 94%. The water was in the 60 degree range. It was warm enough the fish were not biting. They were tucked in deep pools in the center of the lakes. I agree with the beaver theory. We had streams flowing good columns of water and the water was still warm. Outside temperatures are warm. Throw in slack water and you'll have warm water. More trees won't solve the problem but less Beavers may."	**DEQ Response:** DEQ encourages land owners to contact the afore mentioned agencies for advice on beaver activity (see response to Jim Paxton Comments). DEQ agrees that water temperatures are likely on the rise, especially considering increased dry conditions of the last 15 years. However, water heating in streams is substantially driven by sun exposure, not just air temperature. Stream-side shade provides the best defense against solar heat gain.
Wood River Land Trust Comments: "Thank you for the opportunity to comment on the Camas Creek temperature TMDL and address elevated temperatures in streams within the Camas Creek subbasin in south-central Idaho. Of specific concern are the analyses of water quality data demonstrating that temperatures are above recommended levels in a number of streams in the Camas Creek subbasin due to a lack of shade. As DEQ looks to meeting TMDL requirements to lower temperatures in the Camas Creek subbasin we believe that protecting healthy riparian corridors for the fish, wildlife, plant life and invertebrates that depend on these areas is critical. Supporting and providing funding for projects that promote canopy	**DEQ Response:** DEQ appreciates the comments from the land trust. DEQ is likewise a strong supporter of stream and riparian habitat protection and restoration. We understand the need for funding of such projects and continue to do what we can with 319 and other funding, although such sources of funding continue to decrease in availability.

cover, woody debris, and increasing the instream flow in these compromised areas will benefit the fishery, environment and recreational communities. As we look at future climate variability, projects decreasing impairment now will help add resiliency for any future instabilities. We appreciate the work that DEQ does in our region to help us gain critical information for our planning at Rock Creek, other WRLT preserves and throughout the state.	

Camas Creek Ranch, Rodney Ray Gonsales Comments:	**DEQ Response:** Although We did not look into the specific history of the Camas Prairie, we are aware that every valley, every stream course in Idaho has a history related to human settlement and land use. We understand that irrigated agriculture has effects on streams, and is a lawful and legitimate use of the streams water. Many streams that we investigate are entirely appropriated for irrigation or other uses. However, our requirements speak to addressing water in the natural channel whenever it is there. Providing adequate shade protects the stream's temperature when water is flowing in the channel. The fact that water may not be in the channel at certain times of year because of diversion and use is not under our jurisdiction. DEQ has produced a companion five-year review document for the Camas Creek subbasin. That document contains substantial information on the biology and habitat of the various streams, their temperature, flow, etc. We believe we have characterized the potential natural vegetation based on remnant groupings of riparian plants in various places throughout the subbasin. Although we cannot know exactly what was in place in the distant past, we believe that we have set reasonable goals to begin the process of rehabilitation of streambanks and stream cover. The environment will usually tell us through time whether specific shade targets are attainable. These targets may be adjusted accordingly in future five-year reviews of the TMDL.
The US Environmental Protection Agency has mandated that the Idaho Department of Environment Quality discover, monitor and protect the citizens of the state of Idaho from all forms of environment pollution. This mandate includes a monitoring system called "Total Maximum Daily Load" pollution. The Idaho DEQ has found the drainage system called the "Camas Creek Sub-basin" consisting of Camas Creek in Camas County and its tributaries to be highly polluted by excess sunlight on the water courses of the creek and its tributaries. The pollution assertedly is very detrimental to fish, salmonids, aquatic life and recreation because of the water being warmed by the sun. The DEQ has studied the effects of direct sunlight on standard test detectors (one meter square plates) in Boise and Pocatello to ascertain the amount of direct sunlight, measured in Kilowatts per square meter or kilowatt hours per square meter per day, to determine the energy impinging upon the Camas sub-basin. Using that data, the people conducting the survey then estimated the stream bank cover by photogrammetric methods (e.g. - 3d pictures.) Some of the surveys were then checked by the onsite use of a detector called the "Solar Pathfinder" in a very limited number of check tests. The DEQ measured the width of some of the stream channels to determine not only the width, but the amount of water flowing in each stream. After gathering all this data, the people conducting the survey then made the determination of the sunlight pollution of each stream at virtually any point. The DEQ then came to the conclusion that virtually all the stream reaches of the Camas Creek system were being subjected to large amounts of solar pollution. Their conclusion about what to do about it was to make it plain that the City of Fairfield government, the county government, private land owners, the BLM, Forest Service and presumably the Idaho Department of Fish and Game at their Centennial Marsh must mitigate the problem by providing vegetation enough to shade the affected streams. Did I find any defects in their methods and conclusions? Below are some observations that I have made: 1. The DEQ apparently did not look into the history of Camas Prairie. 2. Addressing that, they would have found that all the flows of the Camas Creek system are adjudicated for irrigation. 3. Following that line of investigation, they could have found 90 year old documentation that all the streams were and are dry by July 1 each year. (see A.M. Piper, "Ground	

Water for Irrigation on Camas Prairie ..." Idaho Bureau of Mines and Geology" Pamphlet #15.) 4. They assumed that the creeks were flowing mid-summer, but on-sight investigation would have made it manifest that none were. 5. They gave no data of stream temperatures 6. They gave no data of damage to fish or aquatic life 7. They gave no data of stream flows 8. They gave no data of the timing of the supposed measurements that they took. 9. Addressing the above, the Camas Creek system ordinarily floods during the snow melt, but all flow has stopped by mid July. 10. Investigation would have shown that the great majority of stream banks have not been seriously despoiled by "anthropomorphic" interference. 11. The salmonids do spawn during the run off. 12. The aquatic life certainly must perish because the streams completely dry up, always. 13. The upper reaches of most of the drainages, above their survey, do remain a viable ecosystem for brook trout and aquatic life, but none of the waters of the streams reach the area of their survey, they either sink in the playas or are used for irrigation. There is no cross valley connection to Camas Creek. 14. The suggestion that there be boating or swimming in these creeks is ludicrous. 15. The DEQ has no idea what the natural vegetative cover was before the valley was settled, so how can they "return it to its natural state" 16. This is an example of someone from the eastern US writing into law and mandating something that cannot be done. Mandating something that seems perfectly logical where every stream flows all the time to cover a local situation where the streams are intermittent is the error of national interference in local affairs. 17. The DEQ obviously made their report without doing field work on site, they go into deep detail of their office methods. 18. The DEQ is hamstrung trying to uphold a ridiculous regulation. 19. To implement the building of "shade" for an intermittent stream would cause major economic hardship for no productive or beneficial reason. 20. The best guess is that the streams are very much like they were before man settled this country. There is no vegetative cover because there is not enough water to sustain it. Maybe the EPA should take it up with God.	

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Appendix G. Distribution List

Wood River Watershed Advisory Group (WAG)

Wood River WAG & Executive Board

NAME	ADDRESS
WAG EXECUTIVE BOARD	
1 - Mark Toone	Livestock Representative 2096 E. 1500 S., Gooding, Idaho 83330
2 - Bryan Ravenscroft	Logging/Timber/Small Business/Industry/Hydropower Rep. 1301 Old Malad River Hwy, Bliss, Idaho 83314
3 - Vacant	Soil Conservation Districts Representative <ADDRESS>
4 - Lynn Harmon	Flood District Representative Big Wood Canal Co., Box C, Shoshone, Idaho 83352
5 - Bill Davis	CAFO/Irrigated Agriculture Representative Rt. 1, Box 1210, Fairfield, ID 83327
6 - Bob Simpson, Chairman	Municipalities/Land Planning/Local Government Rep. 20502 Main St., Carey, Idaho 83320
7 - Patti Lousen	Environmental/Conservation/Multiple Use/ Recreation Rep. 119 E. Bullion Street, Hailey, Idaho 83333
8 - Carol Blackburn	Alternate to Environ./Conserv./Multiple Use/ Recreation Rep. Box 330, Shoshone, ID 83352
9 - Daryle James	Public at Large Representative Box 223, Hailey, Idaho 83333
WAG MEMBERS	
10 - Blaine County SCD	P.O. Box 246, Carey ID 83320-0246
11 - Blaine Co. Commissioners	206 1ST Avenue, Suite 300, Hailey ID 83333
12 - Chuck Pentzer, ISWCC	20 West 100 South, Jerome ID 83338
13 - Dennis Strom	P.O. Box 137, Hill City ID 83337
14 - Scott Boettger	Wood River Land Trust, 119 East Bullion, Hailey ID 83333
15 - Judy Brossy	P.O. Box 424, Shoshone ID 83352
16 - Lee Brown	P.O. Box 4068, Ketchum ID 83340
17 - Deb Bumpus	HC 64, P.O. Box 8291, Ketchum ID 83340
18 - Camas Co. Commissioners	P.O. Box 430, Fairfield ID 83327
19 - Camas SCD	Box 156, Fairfield ID 83327
20 - Ed Cannady	HC 64, P.O. Box 8291, Ketchum ID 83340
21 - Dan Armstrong	ITD - District 4, 216 South Date Street, Shoshone ID 83352
22 - Betsy Castle	P.O. Box 2749, Ketchum ID 83340
23 - Richard Curtis	2193 South 1700 East, Gooding ID 83330
24 - Kathryn Goldman	119 E. Bullion St., Hailey ID 83333
25 - Dana Gross	Nature Conservancy, 116 1st Avenue North, Hailey ID 83353
26 - Walt Locke	805 California, Gooding ID 83330
27 - Steve Thompson	820 Main Street, Gooding ID 83330
28 - Mel Fletcher	General Delivery, Fairfield ID 83327
29 - Bob Frostensen	Rt. 2, Box 1040, Fairfield ID 83327
30 - Gooding Co. Commissioners	P.O. Box 417, Gooding ID 83330

31 - Polly Ann Huggins	820 Main Street, Gooding ID 83330
32 - Jim Speck	Box 1374, Sun Valley ID 83353
33 - Dave Skinner	Box 189, Fairfield ID 83327
34 - Dana Sturgeon	723 West 7th Street, Shoshone ID 83352
35 - Dennis Koyle	1556 East 1800 South, Gooding ID 83330
36 - Mike Sliman	P.O. Box 491, Gooding ID 83330
37 - Leavell Cattle	Box 54, Gooding ID 83330
38 -Kevin Lenane	P.O. Box 6370, Ketchum ID 83340
39 - Lincoln Co. Commissioners	111 West B Street, Shoshone ID 83352
40 - Bruce Lium	P.O. Box 1979, Hailey ID 83333
41 - Jo Lowe	P.O. Box 3266, Ketchum ID 83340
42 - John Madden	Box 95, Fairfield ID 83327
43 - Paul McClain	400 West F Street, Box 2-B, Shoshone ID 83352
44 - Joe Schwarzbach	P.O. Box 156, Fairfield ID 83327
45 - Bob Muffley	Box 85, Wendell ID 83355
46 - Sun Valley Water & Sewer	P.O. Box C2410, Sun Valley ID 83353
47 - NRCS - Shoshone	P.O. Box 398, Shoshone ID 83352
48 - Dwight Osborne	1303 East 2500 South, Hagerman ID 83332
49 - Dave Parrish	318 South 417 East, Jerome ID 83338
50 - Lou Pence	1960 Highway 26, Gooding ID 83330
51 - Larry Pennington	336 South 300 East, Jerome ID 83338
52 - Tim Pereira	1884 South 2100 East, Gooding ID 83330
53- Pete Ridder	Camas High School, P.O. Box 307, Fairfield ID 83327
54 – Sue Switzer	IDEQ-TFRO
55 – Shell Howard	IDEQ-TFRO
56 – Rich Bupp	IDEQ-TFRO
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